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ARTICLES

THE ERADICATION OF *ANOPHELES ALBIMANUS* IN PUERTO RICO—AN ECOLOGIC DISCUSSION

JOHN M. HENDERSON, C.E.

PART II

III. Environmental Factors Affecting Operations

Success in eradication requires that there be protection against infiltration from outside areas during and following eradicative activities and that the unit and total area of species occurrence not be too great. Some domesticated species are biologically self-limited to isolated pockets (unit areas) composed of urban areas, thus simplifying the mopping-up task, preventing infiltration, and limiting the size of the self-contained, useful-unit of operation. With many other species, including *An. albimanus,* island situations generally are necessary to avoid infiltration in the form of direct flight from outside areas. This factor, as well as the hazard of re-introduction by land, air and water transport, would make impossible the eradication of *An. quadrimaculatus* from individual municipalities, counties or states in this country which are bordered by other "quad" breeding terrain.

The island of Puerto Rico is about 100 miles long and 30–35 miles wide. Nearby are six small islands totalling about 100 square miles in area, which belong to Puerto Rico. Aside from these, no land is within some 50 miles of Puerto Rico. The total project area of 3,534 square miles is somewhat larger than might be desired from the standpoint of economy in cost of eradication, but does not *per se* make the undertaking impractical.

The feasibility of eradication in Puerto Rico is enhanced considerably by the mountainous divide running in an east-west direction, forming the long axis of the island. The elevation of this divide, which ranges from 2,000 to 4,300 feet except where it slopes into the sea at its termini, is not considered a barrier against production or flight of the species by virtue of sheer elevation above sea level. Ruggedness of slope and dense shading by tropical rain forests resulting from greatly increased precipitation on the mountain sides do, however, largely inhibit production within at least two miles of the divide on either side. In the remainder of Puerto Rico, the species may be found girdling the island in a nearly continuous belt. Production is greatest in the flat coastal plains nearest the sea, diminishing rapidly toward the mountains, except in tongues formed by stream valleys.

Tactically, this rugged backbone permits reducing the average width of front to something less than half the width of the island. An offensive could advance laterally along the shore line with one flank protected by the sea and the other by the mountains. The primary front (in flat plain lands where breeding surfaces and species abundance are greatest), rarely would exceed five miles in width, and the secondary hilly front five to 15 miles. In the southwestern corner of the island, the desert-like Lajas Valley between the hills and the sea would provide a starting point in the form of an easily developed buffer zone furnishing protection against infiltration from the rear. The main buffer zone straddling the long axis backbone would be occupied by a light holding force as insurance against cross-divide infiltration into the sanitated coastal zone.

The present human population of Puerto Rico is approximately two million, a density of nearly 600 persons per square mile. This is concentrated in the coastal plain areas. Such a high density of human population in the com-

bat zone can only impede mobile tactical operations in either insect or human warfare. One of the major problems created is the necessity for disinsectizing the heavy stream of vehicles passing from unclean into clean zones at all hours of the day and night. The political complications alone which might arise from inept management of road blocks deserve more than passing notice.

On the other hand, the great density of human population has caused the elimination of significant wild life values on the island, and hazards in this quarter resulting from the application of insecticides should not be encountered.

Some agricultural hazards are present. Principally, these involve possible harm to the beneficial insects of sugar cane culture, to the consumers of refined sugar, sugar, sugar by-products and sugar on the stalk, and to milk consumers, which might result from the repeated application of heavy dosages of DDT. Rice cultivation is virtually absent in Puerto Rico, sugar being the only significant irrigated or wet land crop. Fortunately, many of the largest and most accessible breeding places in Puerto Rico comprise cut-over mangrove swamps and the margins of uncut mangrove swamps. These possess no significant wild life, agricultural or other economic value other than the wood itself which is used for charcoal making.

IV. Hazards of Reintroduction

Following eradication, the species could be transported to Puerto Rico in the adult stage by airplane or boat, or less likely in the immature stage by boat. Eradicative operations would be justified only following field observations indicating that *An. albimanus* never would be reintroduced, or that this would happen rarely and could be coped with readily.

Administratively, adequate safeguards against introduction by airplane are provided by the foreign quarantine regulations of the U. S. Public Health Service. Actually, some increase in inspectorial service, and improvement in disinsectization practices by airplanes before landing would be warranted to insure maintenance of eradication. Baggage and cargo compartments are especially suspect. The picture is complicated by the use of minor airports by chartered airplanes engaged in international travel.

Little is known of the hazard offered by small inter-island vessels which visit other West Indian islands and stop at many ports in Puerto Rico. Many of these are sailing vessels on unscheduled runs. Entomological inspection as a foreign quarantine activity has not been available at ports other than San Juan. Close entomological surveillance to evaluate this hazard should precede eradicative operations. Perpetual entomological inspection of all inbound water and air transport from *An. albimanus* areas probably would be indicated as a precautionary measure. This should include military and naval surface vessels and airplanes.

The second and most vital line of defense would be an entomological intelligence service for the prompt detection of an enemy landing at any of the critical ports of entry, and a skeleton security force to repel the invasion. The role of quarantine is to make reinvasion an improbable happening, but catastrophe could come only if facilities for repelling the rare invasion were too little and too late. The financial requirements for such an intelligence and skeleton security force probably would range between $50,000 and $100,000 in annual cost, assuming able management of the work and freedom in the selection of personnel. The knowledge and skill acquired in island-wide eradication would be important assets which would help to insure adequacy of protection with a small intelligence and security force.

V. Design of Eradication Operations

The basic justifications for eradicating *An. albimanus* in Puerto Rico are the incalculable economic and social costs of malaria over the past four centuries, the greater economy of eradication as compared with the cost of perpetual malaria control, and the apparent infeasibility of

malaria eradication due to the certainty of frequent reimportation by human carriers from other West Indian Islands and South America.

Ecologic and insecticidal factors favoring the feasibility of eradicating the species in Puerto Rico offer promise that this goal may be achieved at some future time, provided island-wide operations are preceded by (1) further bionomic studies to reduce the number of lacunae of major significance; (2) a successful demonstration of *albimanus* eradication on a smaller scale under reasonably comparable conditions; and (3) a carefully prepared plan of operations which utilizes these additional data and experience. The author is of the opinion that island-wide eradication undertaken without these prerequisites would invite certain failure, and that final decision as to feasibility of the project should not be made at this time.

The case for "pilot plant" eradication is especially strong. Such a project would provide data for more accurately estimating the cost of larger scale operations and would serve as a proving ground for technologic and other operational procedures. Properly controlled, it would tend to resolve into one conclusive answer the effect of many obscure biologic factors. The key principle of eradication is the elimination of the last specimen. Bionomic studies mainly reveal the environmental responses of most members of the species, or representative members, rather than the abnormal manifestations of the hundred millionth individual on which the success or failure of eradication may rest. Legislative appropriations and authorization for the large scale operation probably can be secured only by prior successful demonstration.

A demonstration area is available in the Island of Vieques, one of the six islands previously mentioned which belong to Puerto Rico. A preliminary analysis of the feasibility of eradicative operations on this island was made by Henderson et al.[13] in February, 1947, and a more complete study in June, 1947, by Andrews et al.[14] Space prevents presenting a complete description of Vieques Island but some information from the author's notes is given below. The island lies beyond flight range of Puerto Rico, is 21 miles long and three to four miles in width. The cost of an eradication project is estimated at $100,000 to $200,000. *An. albimanus* occurs in reasonable abundance and may be found in a variety of breeding places, including small streams, mangrove swamps and wet pasture lands. The inherent difficulty of eradication is somewhat less in Vieques than in the main island of Puerto Rico. This is due principally to the absence of irrigated sugar cane as a complication and to the large cattle population which theoretically favors the effectiveness of adulticiding. Production may be found, however, in association with upland sugar cane production and in this respect conditions on the main island are simulated.

Although secondary reliance might be placed on adulticidal measures wherever they give promise of providing substantial aid toward eradication, bionomic considerations dictate selection of larviciding as the main weapon. Swamps, marshes, alkali flats and wet meadows could be treated most effectively by airplane. Linear situations including ditches and small streams should be treated by hand, using the air-borne mist technique. Power operated ground equipment could be used to a limited extent for some breeding surfaces. The insecticide used would be DDT and/or its more recently developed competitors. Dosages applied to most breeding surfaces could be increased markedly over the maxima permissible where wild life values exist. This advantageous circumstance, augmented by the application of two or more closely spaced treatments within each breeding

[13] Henderson, J. M., Palacios, L. D., and Stephens, P. A. Feb. 1947. Unpublished Memoranda of Dep't of Health of Puerto Rico.

[14] Andrews, J. M., Tetzlaff, Frank and Trapido, Harold. Report on the Feasibility, Procedure and Cost of *Anopheles albimanus* Reduction in Vieques, Puerto Rico. July 1947. Unpublished.

cycle, should greatly increase the effectiveness of larviciding as an eradicative technique.

The high kill which it is believed can be obtained by larvicidal measures, and the more moderate kill of imagoes which probably can be obtained even by a combination of adulticidal measures, invites speculation as to eradicative procedures.

Theoretical concepts of preventive medical practice commonly favor the comprehensive attack. When these are applied to the present situation of insect warfare, they encourage placing great attention on adulticidal measures, for the purpose of strengthening this weak link in the eradicative attack against *An. albimanus*. In support of this principle are the facts that eradication solely by anti-larval measures requires that (a) the measures be continued until the last surviving gravid female has died from natural causes, and (b) the effectiveness of anti-larval measures plus the natural death rates of immature and mature stages will be great enough to bring this about in a reasonable period of time.

The military scientist on the other hand, favors exploiting the enemy's weakness (i.e., his own strength) at the expense of other directions of attack. In this way, superior striking power at the point of intensive attack is achieved. Other offensives are mounted only when there is a surplus of strength. In the tropics, the competent tactician in insect warfare subscribes to this principle for its intrinsic worth and for the added urgency of simplifying operations to conform to the capabilities of the project force.

In the current instance an average reduction of 95% in larval population per application of DDT larvicide probably can be expected, especially in view of the high dosage rates contemplated. (In many breeding places 100% kill will be obtained, but in others some larvae will escape, and a few minor breeding places may be overlooked). Two applications on adjoining days theoretically would accomplish a cumulative reduction of 99.25%, a survival rate of 0.75%.

An intensification of larviciding to increase the average kill from 95% to 96% would effect a further reduction of 80% in the survival rate (from 0.75% to 0.16%). Superficially, this marginal increase in larvicidal effectiveness would have the same ultimate effect as a comprehensive complementary attack against the adult resulting in an 80% reduction in the adult population at large. The fact that the single gravid female may be the future source of several hundred larvae does not alter this theoretical principle where larviciding is to be recurrently practiced throughout the life span of the last surviving gravid female. Other considerations, however, may justify prosecuting adulticidal methods, even though these may be far less effective than larviciding. A reduction of 50% in the adult population at large for example, might possibly cut in half the life span of the last surviving gravid female. In general, adulticiding will prove desirable only if the project management and organization are able and adequate enough to prosecute both activities without injury to the larviciding program. (The percentages given above are hypothetical, and only partly supportable by experience.)

Present techniques for sampling populations of *An. albimanus*, although reliable for malaria control purposes, are far from sensitive enough to meet optimum standards in eradication. Adult collections rather than larval possess greatest significance as a measure of interim progress and final success or failure in eradicative operations against this species. The principal adult collecting devices are the animal bait trap and the electric light trap. These are especially insensitive in recording the presence of very sparse populations of *An. albimanus*. Since a few remaining survivors may escape detection, operational failures may be concealed until substantial recovery of population has taken place. This weakness may be correctable in part by improved collecting procedures, but its fundamental basis is the sylvan-like

behavior of the adult. Hand catching of specimens at night from habitations, stables and pastured cattle may prove desirable. Inspectorial activities for the collection of immature and mature specimens occupy a role of high importance in eradicative operations.

Studies which should be undertaken concurrently with the Vieques demonstration toward evaluating the feasibility of eradication in the main island of Puerto Rico include:

1. Determination of safe dosages of DDD as a substitute for DDT in wet dairy pastures and some other situations.
2. Intensive inspection of small inter-island sailing vessels for mosquito specimens.
3. Effect of DDT or related insecticides at varying dosages on sugar cane—economic, entomological, botanical and pharmacological aspects.
4. Further studies on the day-time resting places of *A. albimanus*.
5. Entomological collections of *A. albimanus* along the backbone ridge of Puerto Rico and in the Lajas Valley area toward evaluating buffer zone properties.
6. Safe dosages of DDT or related insecticides where snail-eating minnows are present in streams (to avoid increasing the schistosomiasis hazard).
7. Precipitin tests of blood-engorged specimens of *A. albimanus* as an aid in planning and determining adulticidal technics.
8. Studies on the possible estivation of immature stages of *A. albimanus*.[14]

VI. Remarks

A plan for eradicating *A. albimanus* in Vieques and of performing certain of the above studies has been under consideration by the Department of Health of Puerto Rico and the U. S. Public Health Service, Communicable Disease Activities. An extended survey was made in 1947 by Andrews and others,[14] in company with Puerto Rico Department of Health and other Insular officials. Subsequently, plans for work in Vieques were interrupted due to change in land ownership, but they are applicable in principle to other small islands.

The program as outlined would involve operational, inspectorial and investigational activities. It is believed that *A. albimanus* eradication on Vieques or a comparable island is feasible in spite of incomplete information regarding the adult behavior of this mosquito. Such a program should provide critical information regarding the technical feasibility and probable costs of island-wide *A. albimanus* eradification in Puerto Rico.

VII. Acknowledgment

The author assumes full responsibility for the text, but gratefully acknowledges the criticisms and advice of the following officers of the U. S. Public Health Service, Communicable Disease Center: Scientist Director Justin M. Andrews, Sr. Scientist S. W. Simmons, Scientist H. D. Pratt, and W. M. Upholt, Biologist.

Mr. Henderson was resident in Puerto Rico for 3½ years. From November 1940 to March 1942 he was Acting Head of the Department of Public Health, School of Tropical Medicine, San Juan, P.R. From March 1942 to February 1944 he was in charge of operations in the West Indies on military base malaria control activities of Malaria Control in War Areas, U. S. Public Health Service, with rank successively of Major and of Lt. Colonel. From December 1942 to February 1944 he was senior member of an Army Malaria Control Board attached to G-4, Commanding General, Antilles Department, with jurisdiction over all Army malaria control through the West Indies, Trinidad and the Guianas. From February 1944 to March 1946, while serving as Chief, Engineering Division, Malaria Control in War Areas Headquarters, Atlanta, Ga., Mr. Henderson maintained general supervision over military base malaria control in Puerto Rico and Jamaica, B.W.I. He is now Professor of Sanitary Science, Columbia University, School of Public Health.

Mr. Henderson's most recent visits to Puerto Rico were as Consultant on Malaria Control to the Puerto Rico Department of Health, February 1947, and as Principal Investigator of a National Institute of Health Research Grant Study of the bionomics of *Anopheles albimanus*, September 1947.

CULEX CHIDESTERI DYAR *(DIPTERA, CULICIDAE)* AT BROWNSVILLE, TEXAS[1]

C. R. JOYCE
S. A. Sanitarian (R), U. S. Public Health Service

Culex chidesteri Dyar was first reported from the United States by Fisk and LeVan (1940) when a single male of this mosquito species was taken in a light trap at Brownsville, Texas. In their paper the possibility of its being introduced by air traffic is suggested. Dyar (1928) lists its distribution as Panama (Colon), Venezuela (Maracay), and Brazil (Porto das Caixas). Randolph and O'Neil (1944) apparently are in error in a statement in their bulletin on Texas mosquitoes that *C. chidesteri* was found by Dyar in Texas.

The present paper records numerous collections of larvae and adults of *C. chidesteri* taken throughout the years 1944, 1945, and 1946 while the author was conducting an entomological surveillance program at Brownsville, Texas, for the Foreign Quarantine Division of the U. S. Public Health Service. The records included herein are thought to be the first for the adult female and larval stages of this species in the United States. Observations on the breeding habits are noted and the species is redescribed. A brief review of the literature concerning this species is also presented.

A New Jersey type light trap was kept in almost continuous nightly operation at the international airport at Brownsville throughout the calendar years 1944, 1945, and 1946. Fifteen specimens (six female and nine male) of *C. chidesteri* were captured in the light trap during this period. The series of catches is as follows: On Nov. 27, 1944, 3 ♂ ♂; Dec. 7, 1944, 1 ♀; Dec. 10, 1944, 1 ♀; Aug. 22, 1945, 1 ♂; Nov. 1, 1945, 1 ♂; Nov. 4, 1945, 1 ♀; Nov. 15, 1945, 1 ♂; Nov. 17, 1945, 1 ♂; Nov. 29, 1945, 1 ♀; Jan. 4, 1946, 1 ♀; May 10, 1946, 1 ♂; May 27, 1946, 1 ♂; June 15, 1946, 1 ♀. In another trap operated at the water port of Brownsville one male *C. chidesteri* was captured on Feb. 14, 1944. The light trap collections indicate that the adults are active in the Brownsville locality throughout the year.

The first larva was found by dipping in the grassy edges of a roadside pond near Brownsville, January 2, 1944. A thorough search was subsequently made to determine the location of larval breeding places. It was desired to learn more concerning the biology and occurrence of the species. The larval collections are presented in the accompanying table.

In addition to the records listed in this paper the author identified larvae collected by D. C. Pfeifer, local mosquito control inspector, at Harlingen and San Benito, Texas. These identifications were reported to the Texas State Department of Health.

The distribution of *Culex chidesteri* in the United States is apparently restricted to the lower Rio Grande Valley of Texas. Larvae were collected only in the vicinity of Brownsville, San Benito, and Harlingen, Texas. The species breeds throughout the year in this area as larvae were collected every month with the exception of July and October. With few exceptions the larvae were collected in two places, both of which appeared ideal for the breeding of this species. Specimens could be found almost anytime during the year, although at times fluctuations in the water level occasioned by the pumping of irrigation water from the river into the resacas and ponds, necessitated excessive dipping. One of the breeding places was a small pond on the Brownsville golf course. This pond had a grassy margin and was overgrown with water hyacinths. The other principal larval col-

[1] From the Foreign Quarantine Division, Bureau of Medical Services, U. S. Public Health Service.

TABLE 1. Larval Collections of *C. chidesteri*

Date	Specimens collected	Locality	Habitat
Jan. 2, 1944	1	Near Brownsville	Grassy roadside pool
June 11, 1944	2	Harlingen, Tex.	Drainage ditch overgrown hyacinth and cattail
Aug. 5, 1944	1	San Benito, Tex.	Grassy roadside ditch
Sept. 2, 1944	1	Harlingen	Grassy roadside pond
Sept. 12, 1944	2	Harlingen	Grassy roadside pond
Nov. 20, 1944	10	Brownsville golf course	Pond overgrown with water hyacinth
Dec. 4, 1944	45	Brownsville	Resaca overgrown with hyacinth and cattail
Mar. 17, 1945	4	Brownsville golf course	Pond overgrown with water hyacinth
May 12, 1945	4	Brownsville	Grassy margined pond with water hyacinth
Aug. 6, 1945	8	Brownsville golf course	Pond overgrown with water hyacinth.
Aug. 8, 1945	18	NE of Brownsville	Resaca overgrown with hyacinth and cattail
Aug. 10, 1945	20	NE of Brownsville	Resaca overgrown with hyacinth and cattail
Aug. 20, 1945	110	NE of Brownsville	Resaca overgrown with hyacinth and cattail
Nov. 26, 1945	2	Harlingen	Grassy roadside pool
Dec. 7, 1945	1	Brownsville	Grassy roadside pool
Feb. 17, 1946	2	Harlingen	Grassy roadside pool
Mar. 26, 1946	1	Brownsville	Resaca overgrown with water hyacinth
Apr. 5, 1946	7	NE of Brownsville	Resaca overgrown with hyacinth and cattail
Apr. 25, 1946	1	Brownsville golf course	Grassy pond overgrown with water hyacinth
June 10, 1946	9	NE of Brownsville	Resaca overgrown with hyacinth and cattail
June 11, 1946	1	Brownsville golf course	Grassy pond overgrown with water hyacinth
June 27, 1946	1	Brownsville	Pond overgrown with water hyacinth
Dec. 4, 1946	62	Brownsville	Pond overgrown with water hyacinth
Dec. 6, 1946	76	Brownsville golf course	Pond overgrown with hyacinth and cattail
Total	389		

lecting place was located approximately one mile northeast of Brownsville on a resaca overgrown with water hyacinth and cattail. "Resaca" is the native term for the ponds or lakes formed by an old river bed. The Rio Grande has changed its course a number of times in the Brownsville area leaving a number of these resacas whose water level is maintained by rains and the pumping in of irrigation water.

The scarcity of *C. chidesteri* in the light trap catches at the Brownsville airport was no doubt largely due to the clearing activities performed within a mile radius of the airport by malaria control crews. The species apparently prefers grassy pools or resacas overgrown with water hyacinth.

A number of other species of mosquitoes were commonly found breeding in association with *C. chidesteri*. The other species frequently encountered were *Anopheles albimanus, Anopheles pseudopunctipennis, Culex peccator, Culex erraticus, Culex salinarius,* and *Mansonia titillans. Culex salinarius* larvae were usually found in the greatest abundance.

In order that there would be no question as to the identification of the species, inasmuch as Dyar's description and illustration are at variance, a number of larvae were reared out to the adult stage. The identification of both larval and adult stages has been confirmed by Dr. Alan Stone of the United States National Museum. The average duration of the pupal

stage in the laboratory was found to be two or three days. Of 71 field-collected last instar larvae held for observation, one adult had emerged within 24 hours following pupation; 21 adults had emerged within 48 hours; and 49 or the remainder had emerged within 72 hours of pupation.

Culex (Culex) chidesteri was described by Dyar (1921) from two denuded males taken on a hospital screen at Colon, Panama, by W. S. Chidester between 7 and 8 a.m. on June 24, 1921. Bonne and Bonne-Wepster (1925) list and describe the male as known from the specimens collected at Colon, Panama. Dyar (1925) lists this species with reference to the original description and speculates as to where the larvae might live. The larva is first described and figured by Root (1927) from larvae collected in a river at a point where it was choked with vegetation, chiefly water hyacinth, at Porto das Caixas, Brazil. All head hairs were denuded in the single larval skin upon which he bases his description. He shows seven pairs of short hair tufts on the air tube all in a straight line. Dyar (1928) summarized all information on *C. chidesteri* with a description of the female, male, and larva. He also figures the male terminalia, the larval head and the larval terminal segments. His adult specimens were partially denuded, however, thus making the description incomplete. The text description of the larva is based on a specimen having the head hairs missing although the illustration, which is apparently based on different material, shows the head hairs present. The text indicates five paired tufts on the air tube, whereas the figure shows seven or possibly eight pairs. Dyar's key to the *Culex* larvae indicates that the subapical tuft is laterad out of line. Due to the above mentioned discrepancies the following description of the species as observed in specimens collected at Brownsville, Texas, is given.

Female: Medium sized species. Head: Proboscis elongate, dark scaled with bluish reflections, pale non-contrasting band in middle usually more distinct and broadly pale on under side. Palpi short, dark. Broad dorsal region of occiput clothed with narrow pale curved bronzy scales and dark erect forked scales. Lateral region of occiput with a patch of broad white scales. Thorax: Mesonotum brown with fine narrow curved bronzy brown scales. Pleura pale brown with small groups of broad white scales. Abdomen: Tergites primarily dark scaled with bronze to metallic blue-green reflections. Basal white bands of nearly uniform width joining a pair of basal lateral white patches. Venter mostly white scaled with usually a few black scales scattered along apical margin. Legs: Dark scaled with metallic blue green reflections, inner surface of femora and tibia white scaled with white line of scales extending down inner side of first tarsal segment; femora and tibia white tipped; tibial spot broader and more distinct than femoral one. On some specimens there is a faint indication of spots or pale rings at the tarsal joints, more distinct on basal joints and on hind tarsi, otherwise tarsi dark scaled. Wing scales narrow and dark.

Male: Coloration similar to that of female but with the narrow white band on proboscis more distinct. Third segment of palp with a pale white band in the middle. Penultimate segment of palp with two ventral white spots, one basal, the other beyond its middle. Distinct apical dark band on venter of abdominal segments. Terminalia: Basistyle conical with large basal hollow, about two and one-half times as long as basal width, vestiture of numerous setae, longer on outer aspects. Subapical lobe prominent, undivided, bearing three rods somewhat hooked at tip, a broad leaf and a seta. Disistyle curved, flattened, thick at base, tapered beyond middle, with short subterminal claw. Tenth sternite crowned with numerous short pointed spines, curved basal arm. Ninth tergite: Lobes widely separated, moderately raised, each bearing several slender setae. Phallosome: Wide, tip excavate, a row of short teeth on margin, a stout tooth arising from base in middle and exceeding margin,

upper arm sheathlike, ventral arm small and thumb-shaped.

Larva: Head broad, wider than long; upper and lower head hairs multiple, feathered, upper usually six branched (6 to 8), lower three branched. Antennae spinose, curved, tuft multiple, feathered, located at outer third, the part beyond more slender. Thorax and abdomen spicular spinose. Lateral comb of eighth segment of many scales in a triangular patch, single scale narrow, fringed with long fine spines. Air tube over eight times as long as wide, slender, only slightly tapered. Pecten consists of small teeth on basal third, terminal teeth more widely spaced. Usually eight pairs (7 to 9) of short delicate four branched hair tufts in a straight line laterad on air tube, first tuft before end of pecten, length of tufts less than width of air tube. Anal segment longer than wide, pilose, ringed by dorsal plate, ventral brush posterior, dorsal tuft a long hair and a long and three shorter ones on each side, lateral hair double, anal gills not as long as the segment, narrow, tapered.

Distribution: Panama (Colon), Venezuela (Maracay), Brazil (Porto das Caixas), and the lower Rio Grande Valley of southern Texas (Brownsville, Harlingen, and San Benito). The species has thus been reported from only a few widely scattered areas but further collecting should no doubt fill in its range of distribution, although its establishment as far north as Brownsville seems unusual.

The larva of *C. chidesteri* may be easily distinguished from other United States species of *Culex* by the following combination of characters: Lateral comb of eighth segment of many scales in a triangular patch, antennae with tuft outwardly placed, part beyond more slender, thorax and abdomen spicular pilose, air tube long about 8 to 1 with 7 to 9 short paired tufts almost in a straight line. Upper and lower head hairs multiple, spined, upper with six and lower with three branches. The larvae could usually readily be identified in the field by the fact that the abdomen appeared banded with the third and fifth segments darker than the others.

The adults are much more difficult to distinguish, especially if the specimens are denuded or damaged as is often true in much of the light trap material. They can usually be identified by the following characters: Pale banded proboscis, femur and tibia white tipped, tarsi unbanded (although on some specimens there are faint indications of spots at the joints), basal white bands of abdominal segments broadly joined with lateral white spots. Some of the females seem to fit into Matheson's (1944) description of *C. declarator* which is reported as occurring at Brownsville. The author did not find any larva of *C. declarator* in collections there.

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DEVELOPMENT AND USE OF THE "ONE MAN UNIT" IN CALIFORNIA

T. G. RALEY
Manager, Consolidated Mosquito Abatement District,
Selma, California

Keeping pace with war-fostered developments, interested mosquito control workers in California have realized that control practices are being streamlined. New insecticides, the airplane, four wheel drive vehicles and the new awareness of the layman that mosquitoes are an economic hazard have pushed work ahead many years. The airplane has been accepted as standard equipment for large scale operations and for areas not readily accessible to ground equipment, and the four-wheel drive truck and concentrated, highly toxic chemicals have made it possible to carry on practical mosquito control from the ground in large districts. These new tools are being used to their fullest advantage in California.

It quickly became apparent that the four wheel drive vehicle was the answer to streamlined ground control. Detailed surveys of districts in California revealed that this unit's ability to travel off the road was making obsolete the practice of hand spraying by large crews and the need for high pressure sprayers with hundreds of feet of hose. Further ob servations indicated that only one man, using application techniques made possible by the new chemicals, could actually turn out more work in a day than two or more men on a truck. Allowed to set his own pace and with full responsibility for a given zone, one man with his four wheel drive unit has stepped up results far beyond the most optimistic estimate.

This very welcome fulfillment of an ideal, good mosquito control in large areas at a reasonable cost, has been further enhanced by the development of dispersed depots. Following in the footsteps of Harold Gray, Engineer of the Alameda County Mosquito Abatement district, nearly all large districts in California have established sub-depots at strategic spots throughout the district. Along with this an effort has been made to hire personnel that live within the zone in which they work. This has not only cut operating costs but has increased the feeling of responsibility each man has for his particular zone. Mingling with neighbors both when on duty and off the job keeps the men more fully informed than they would be if they came into the area each morning and left each night.

Utilizing this one man unit for mosquito control to its fullest extent has necessitated development of several practical innovations. Probably no two districts in California see eye to eye on all aspects of the problem, but this has been a very wholesome and worthwhile condition. This initiative has developed some very practical ideas that are now more or less standard. Not to confuse the issue and to confine this paper to familiar ground the "One Man Unit" used at the Consolidated Mosquito Abatement District in Fresno County, will be outlined.

Based on past experience the quarter ton, four wheel drive truck was selected as the standard field unit at Consolidated. This sturdy, light weight unit was mobile in nearly every type of terrain accessible to man. Commonly referred to as the "Jeep" this truck had proven itself in one battle and seemed the most logical selection for the battle ahead. Economical to operate and stripped of all fancy trimmings it is ideally suited for work off the road. With the addition of proper equipment a driver could go into nearly any field and do mosquito control from the seat of the truck. Heavier trucks were limited in their field of operation and of course were much more expensive to maintain. Now that the field operator can work several hours with only a few

gallons of concentrated insecticides, plus readily available water, the need for large trucks has diminished.

Another standard piece of equipment at Consolidated is the Essick air pressure sprayer. As a companion to the Jeep, this sprayer holds up its end nicely. The 65 gallon tank with the light-weight air compressor mounted on top, fits into the bed of the truck with room to spare. Mounted parallel with, and directly over the rear axle, with the compressor on the back for easy accessibility, the sprayer's weight is well distributed. To help support the spray rig when it is filled and working in rough fields, two extra spring leaves are added to each of the regulation rear springs. Operational advantages of the Essick are manifold.

Using air pressure built up in the material tank as a propellant eliminates the need for any of the spray liquid to come in contact with any moving part of the sprayer. Because of the corrosive and abrasive properties of some insecticides, this has been a distinct asset. The minor repair work necessary to maintain this unit during a season's operations is a welcome relief. The reservoir of air pressure within the tank is a time saver for the men whenever they have small areas to spray. Once charged, the sprayer will operate for some time without the compressor running. The Essick can be used for many other purposes; namely, painting, cleaning equipment, servicing tires, charging hand spray cans, etc. Light-weight, two braid, ⅜ inch neoprene hose completes the spray unit. One man can conveniently handle up to 150 feet of this hose.

A recent development at Consolidated has been a modified spray boom. Anchored to the rear of the truck bed extension this spraying aid is actually nothing but a glorified nozzle attached to the spray rig. Made up of ¼ inch pipe, two 8002 spray heads pointing to the rear, two homemade nozzles tilted at a 30° angle at the ends, with a valve to shut off one side, this boom is out of the way and is short enough to be protected by the bed of the Jeep. A reasonably uniform deposition of spray material is spread over a 30 to 40 ft. swath, depending on the wind. For ditches or narrow ponds one side can be shut off without materially decreasing the distance covered by the spray.

The truck bed extension is made by using the tail gate and a length of 10 inch, 16 gauge sheet iron. This sheet iron is fitted to the outside edge of the tail gate, turned at the edge and ends and bolted to the bed of the Jeep and the tail gate. To give the bottom (tail gate), added support, a piece of strap iron is anchored to the outside edge of the tail gate and to the bed of the truck, near the top edge. This extension will hold 3 to 5 five-gallon cans, which is adequate for any one day's supply of concentrates. As a general rule the men carry as little as possible in this compartment to keep weight down.

Alongside the spray tank, bolted to the shelves covering the rear tires, is a tank for aerosol liquid on the left, and a tool box on the right. The aerosol tank holds approximately 12 gallons of material and is fitted with a wide mouth fill cap and a breather line. The tool box, 9 x 14 x 28 is large enough to hold all miscellaneous tools, rags and a gallon can for extra gas.

On the dash board to the left of the steering wheel is a first aid kit. Over the instrument panel on the windshield frame is a "catch-all" box. Used to hold flashlight, pill boxes and all the other odds and ends of the trade, this compartment is divided into sections for easier convenience. This box plus a clip board is the field office equipment. On the right cab panel, just under the dash, is a fire extinguisher, a must for all vehicles. To the left of the driver, between the seat and the side board is the control valve for the aerosol exhaust generator.

The hand sprayer, a three gallon air pressure model, is mounted on the side of the cab, just behind the front fender. The hanger is made from 8 inch well casing supported by the Jeep step and

brackets bolted to the side panel of the cab. A piece of 2 inch pipe is welded to the well casing to hold the spray wand. Gaskets made from old bicycle tires or inner tubes are fitted to the top edge of the casing to eliminate rattles. The top of the hand sprayer is fitted with a valve which can be used for charging the sprayer with air pressure from the Essick.

The aerosol generator is fitted to a "tee" which is welded to the exhaust pipe, cut off approximately 4 inches from the manifold. A hole is cut in the fender apron just above the body frame and the pipe of the generator is coupled to the "leg" of the "tee." For greater efficiency of Jeep operation in normal driving, a quick opening gate valve is installed on the bottom "arm" of the "tee," and connected to the muffler. When this valve is open, all the exhaust gases are forced through the regular exhaust line by plugging the opening of the generator. A spring hanger, anchored to the side of the fender, is used to support the generator. An air vent, controlled by a gate valve, is installed in the feed line to reduce carbonizing. To increase the range of the generator, 6 foot lengths of flexible tubing are used to direct the fog into culverts, buildings and other confined areas. The "Plumber's Nightmare" is a very handy gadget to have around when the going gets tough. The very positive results obtained from its proper use against both mosquito larvae and adults, are a welcome aid to good public relations.

Without minimizing the benefits of temporary relief achieved by proper larviciding and adulticiding this one man blitz will be truly effective only if steps are taken to establish sound, permanent control. A full understanding of the actual and potential mosquito problem, plus a well conceived educational program aimed at reducing sources of mosquito larvae will pay dividends to all parties concerned. Well trained personnel with a desire to achieve this end is the best security any district can have.

NOTES ON THE MOSQUITO, *URANOTAENIA SYNTHETA* DYAR & SHANNON (DIPTERA: CULICIDAE)

OSMOND P. BRELAND
The University of Texas

The mosquito, *Uranotaenia syntheta* Dyar & Shannon was described in 1924 from a single female that had been reared from a larva collected at Mission, Texas (Dyar & Shannon 1924). The male was not known at that time, and the larva from which the female was reared was not described. The status of this species remained somewhat in doubt for many years, but in 1943 Dampf described the male, and stated that the species was rather abundant in parts of Mexico (Dampf 1943). The larva was described in 1946 from a single specimen collected at Forth Worth, Texas (Porter 1946). Although this larva was not reared to an adult, it was thought probable that it was *Uranotaenia syntheta* since it differed from the larvae of *U. lowii* and *U. sapphirina,* the only other species of *Uranotaenia* known to occur in Texas. A male of *U. syntheta* was also collected from the same area which supported this conclusion.

Collections of this species in the United States have been relatively rare, and in most instances the mosquito has been represented by only an individual or a very few specimens. So far as could be deter-

mined, the species has not been recorded from this country except for a few localities in Texas.

During 1947 the writer made several collections of mosquitoes in Palmetto States Park, some eight miles south of Luling, Texas. A total of several dozen larvae of *Uranotaenia syntheta* in different larval instars were taken May 14, 22 and June 17. The larvae were found in small depressions along a stream that contained masses of water hyacinths. Larvae of *Culex salinarius* were also found in the same depressions, but no other species of mosquitoes were represented. The larvae of *U. syntheta* were brought into the laboratory, and although larval mortality was rather high, several adults of both sexes emerged.

These collections indicate that *U. syntheta* may not be as rare in parts of the United States as formerly supposed, and it is thought probable that more intensive collections in some areas will yield many specimens. It is possible, however, that special conditions are necessary for the breeding of the species in large numbers. The depressions mentioned above are the only places where larvae have been found, although a large number of collections at different times of the year have been made in that vicinity. Larvae of *U. lowii* and *U. sapphirina* were collected from a grassy swamp less than 50 yards away, but no *U. syntheta* were recovered from this area.

Larvae of the same series from which adult *U. syntheta* were reared were compared with the description of the larva by Porter (1946). The larvae differed in some structures from this description, but these differences may well be individual variations that may be expected to be found in a series of most organisms. At present the writer is inclined to believe that the larva described by Porter was that of *U. syntheta.* The study of this species is continuing.

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HEDGES OF *BROMELIA PINGUIN* L. A SOURCE OF MOSQUITO BREEDING IN HAITI

LEON DALENCOUR

Ingéneur Civil, Spécialiste en Drainage,
Port-au-Prince, Haiti

In a letter to the Secretary, Leon Dalencour, Civil Engineer and Specialist in Drainage, Rue Benito Juarez, 55, Port-au-Prince, Haiti, writes:

"I have resigned from the Malaria Control Section here in Haiti. My interest, however, did not decrease concerning the activities of any organization dealing with mosquito or malaria control; and I avail of the opportunity to send you the following communication which may prove of publication value.

"I was going to consider as a failure the extensive drainage work carried on by the Malaria Control Section so far as mosquito control is concerned in the town of Aquin, Haiti. Although decreasing, the outbreaks of mosquitoes were rather serious seven days after any rainfall and the remaining crab holes could not be

obviously accounted for such swarms. Finally came a long period of drought where the pests were very scarce in town. One afternoon I was hunting in a neighboring well-drained field when at my great surprise, I was followed by a few dozens of mosquitoes. These seemed to come from the thick bushes efficiently used as fence in that particular zone of the country. In fact, the bush is constituted by a densely growing herb called "Pingouin" by the natives. We identified it as being the *Bromelia pinguin* L. of the Bromeliaceae family. Each leaf makes a cup at the place where it meets the stem and the dew accumulates there forming a well shaded and secluded ideal breeding basin.

"I am going to advise the Public Health Administration here so that a campaign may be initiated against this natural ally of the mosquito, in its unceasing fight towards human health."

(Signed) LEON DALENCOUR

THE PLUMBER'S NIGHTMARE "GROWS UP" AND NOW HAS A "COLT"

(An example of the far-reaching influence of MOSQUITO NEWS, and of the desirability of publishing descriptions of your own new ideas for which someone likewise may be waiting.—*Editor's note.*)

Ted Raley, manager of California's Consolidated MAD recently received the following letter:

Dear Sir:

Thinking that you would be interested in some of the uses that have been made of the "Plumber's Nightmare" described by you in Vol. 7, No. 2 of MOSQUITO NEWS, I am forwarding pictures and information. When Dr. Reeves came to this station in connection with an investigation of possible encephalitis here on Guam, he brought along a copy of the above mentioned MOSQUITO NEWS. A more timely article could not have been obtained as we were doing everything we could to control adult mosquitoes, using "Fogging Jeeps," with very poor success. We had used two methods of DDT aerosol generation and neither was successful.

Here on the Medical Center, an area of several hundred acres, about ⅔ is jungle, we have a rather unique control problem. The species of mosquito which is most abundant is *Aedes pandanii,* which breeds in the axils of the Pandanus bush and tree. These grow profusely in jungle areas that are inaccessible to any type of spray rig, making it necessary to practice adult control which you know is the hard way of controlling mosquitoes.

The first "Plumber's Nightmare" was used on a jeep with excellent results, followed by installation on a second. Due to the worn-out condition of the jeeps they lasted a couple of months as "foggers." As far as we could determine, the installation of the venturis did not hasten the wearing. We next installed a venturi on a 115 H.P. 6 x 6 engine set on a trailer, this one was really a honey, gave excellent results. We used 2 inch pipe with a 1 inch venturi, putting out about 55 gallons of 10% DDT per hour. This motor also gave up, timing chain troubles, no replacements. At the present, we have a weapons carrier that is giving good results, both in larval and adult control.

We were able to control flies in the galleys in areas that could be hit by the aerosol but since we could not get overall coverage, using the vehicles, the kill was not as complete as was desired. With this in mind we decided to do a little experimenting. We took a one cylinder

motor, used ¾ pipe with a ⅜ inch venturi, installed a tank and placed the entire rig on a small two-wheel cart that could be rolled in and out of buildings with ease. Using a 10% solution of DDT in diesel oil and xylene we believe we are getting a 100% knockdown on flies in the galley, mess-halls, and wards where it is being used. As you mentioned in your article, there seems to be no residual value from the aerosol, but the contact kill is excellent. The venturi rig uses about 2 gallons of solution per hour. So far, we have received no complaints, only favorable comment on the absence of flies. Incidentally, the rig is rather spectacular looking and draws favorable publicity—no hindrance at all in accomplishing our job.

I noticed in the concluding paragraph of your article that you intend to continue research into the effectiveness of the aerosol generator, any new information as to uses and performances that you have obtained would be greatly appreciated. We feel that this method of DDT dispersal is the best suited for the control problems found on this base. If there are any questions I might answer in regards to the performance of the "Plumber's Nightmare" under tropical conditions, I will be more than happy to do so.

Yours truly

(Signed) RALPH CROWE, HMC, USN

In a recent note dated July 15, Mr. Crowe said that he has been transferred to San Francisco, where he hopes to have an opportunity to talk to Mr. Raley. We shall undoubtedly learn more about his experiences via MOSQUITO NEWS.

H. L. T.

The "Colt"

"The Plumber's Nightmare—has a Colt"

NEWS AND NOTES

DEVICE FOR KILLING MOSQUITOES IN AIRCRAFT DEMONSTRATED BY BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE. On August 20, 1948 members of the staff of the BEPQ demonstrated an automatic aerosol distributing device in an Army C-47 plane in flight to some 65 officials of the Army, Navy, Air Force, Public Health Service, Civil Aeronautics Administration, Pan American Sanitary Bureau, British Armed Forces, British Commonwealth Scientific Office and United States Department of Agriculture.

Mosquitoes, flies, Japanese beetles, grasshoppers and other insects were released in the plane after the take-off and for three seconds the aerosol was released. The knock-down and kill of the insects were then observed, also the effect of the insecticide on the officials. The results were entirely satisfactory and only one sneeze was heard.

The device demonstrated is a flexible manifold system which has been mechanically perfected for use of a satisfactory aerosol formula. The equipment consists essentially of a centrally located aerosol supply tank from which copper tubing connects to electrically controlled valves containing aerosol nozzles. The latter are so located that, as the valves are operated by a single switch with an automatic time control, the insecticidal aerosol completely fills the plane and comes in contact with insects that may be present. A counting device automatically registers each time the aerosol is released.

Work on this project was originally initiated several years ago by the Pan American Sanitary Bureau and the Navy and has also been participated in by a number of other agencies including the U. S. Public Health Service, the Bureau of Entomology and Plant Quarantine of the Department of Agriculture, and the Department of the Army. The British, also recognizing the need for controlling insect hitch-hikers in planes, tested a different type of apparatus for that purpose as early as 1938.

For the development of this device credit goes largely to Donald Snow of Pan American Sanitary Bureau and C. S. White of the Navy and for its perfection to A. H. Yeomans, W. N. Sullivan, and O. C. McBride of the Bureau of Entomology and Plant Quarantine.

It is planned to try the equipment on several different types of planes and ultimately bring it into general use.

F. C. BISHOPP

THE JOINT MEETINGS—AMCA AND CMCA. Great events are forecast for the Annual Meetings of the American Mosquito Control Association to be held jointly with the California Mosquito Control Association next February in Berkeley, California. As yet, there is only an outline of the tentative program; but it can be reported that there is planned an International Day for Feb. 7, an AMCA Day for Feb. 8, and a CMCA Day for Feb. 9. Harold Gray, AMCA First Vice-President, is Chairman of the Program Committee for that association, and Ed Washburn is in charge of general organization for California. A marvelous route is mapped out for the Caravan, Feb. 10–14. Yosemite, a Fresno winery, some mosquito abatement districts, and Hollywood are included in the itinerary. A detailed program will be printed in the December MOSQUITO NEWS

According to Ted Raley, President of the CMCA, California is tops. But can this Convention equal or surpass that of the Floridians, last spring at Fort Pierce? Will the weather be as balmy, or the coffee as good?

FOR THE ANSWER, BE IN CALIFORNIA, FEBRUARY 7–14, 1949!

H. L. T.

PROGRAM COMMITTEE PREPARES TENTATIVE OUTLINE FOR 1949. On June 15, the CMCA Program Committee met to conduct early planning for the joint meeting of the California Mosquito Control Association and the American Mosquito Control Association to be held in Berkeley, California, Feb. 7, 8, and 9, 1949. A three-day conference featuring an International Day, an American Day, and a California Day, was proposed and tentatively agreed upon by the Committee. Business sessions of both Associations will be held in the evenings, with a Dinner-Dance scheduled in between to provide social color to the event.

Following the Conference, a tour of the various representative mosquito abatement districts in California, to include several by-points of interest, is slated. A caravan will be assembled in Berkeley and take interested persons from Alameda County via the Central Valley south to even include Hollywood. Coming?

MOSQUITO BUZZ

HAROLD GRAY RECEIVES PUBLIC HEALTH POST DISTINCTION. Harold Gray, Engineer of the Alameda County Mosquito Abatement District, aside from his well established place in the field of mosquito control, has recently been given further prominence in the related field of public health, being elected President of the Northern California Public Health Association.

MOSQUITO BUZZ

F. Y.—'49 STATE AND C.D.C.A. PERSONNEL ON MOSQUITO CONTROL ACTIVITIES. A synopsis of State and C.D.C.A. personnel to work on Bureau of Vector Control activities in California during fiscal year 1949 reveals staff assignments as follows:

R. F. Peters, Sr. Vector Control Specialist—

Mosquito Consultation Services, including editorship of the BUZZ.

R. F. Portman, W. J. Buchanan, and R. W. Jones, III, Vector Control Specialists, C. E. Snyder and James Bray, Sanitarians—Subvention and District Relation Activities.

H. I. Magy, Vector Control Specialist, S. E. Kirkwood, R. C. Foreman, G. Campbell, R. C. Officer, and T. Yamashida, Entomological Inspector—Airplane Studies at Merced and Kern.

B. G. Markos, Entomologist—Prehatching *Aedes* Studies at Merced.

Roy Fritz, E. Meyers, and W. W. Firth, C.D.C.A. Entomologists—Encephalitis Virus Recovery Studies.

N. S. Wysong, Entomological Inspector—Central Valley Project.

Student Research Assistants assigned to the Ground Aerosol, Toxicity and Sewer Farm Studies, include: Jim Witt, Ed Loomis, Tom Bowles, and Maurice Deutsch.

A vacancy exists on the Central Valley Project for a P3 Engineer, either Civil, Sanitary, or Agricultural.

All Bureau activities are coordinated by Arve H. Dahl, Chief, Bureau of Vector Control.

Mosquito Buzz

Coachella Eye Gnat Studies Show Need for Further Work. Studies by the Bureau of Vector Control in the Coachella Valley this spring on the evaluation of established methods of mosquito control as applied to the control of the *Hippelates* gnat netted little as such and points out the need for concentration on future studies to determine an economically feasible method of gnat control instead.

The mosquito control methods tried against the gnat were as follows: 1. Pre-emergence treatment—DDT dust and DDT emulsion were applied to two separate plots at the rate of one pound of DDT per acre. Effective results endured for about three weeks.

2. Ground aerosol—DDT aerosols in diesel oil were applied to two plots at .3 and .4 pounds of DDT per acre, resulting in immediate reduction of the gnat population, but with build-up in a day or two.

3. Plane treatment—DDT emulsion sprays and DDT in oil solvent as an aerosol were applied to two plots at .4 of a pound of DDT per acre. Immediate reduction of the gnat population resulted, but build-up occurred again very soon.

Entomological observations are being continued throughout the year in order to obtain further ecological understanding of the gnat species.

Mosquito Buzz

Consolidated MAD Using Small Oil Gun for Small Sources. The Greco S-575 oil gun which was demonstrated at the Spring Conference in Fresno by the Consolidated MAD has been found to be most practical in the control of small sources of mosquitoes. The gun has a capacity of 1½ pints and is easily outfitted with any type of nozzle. Its small size and light weight make this gun a pleasure to the inspector, especially in following up service requests. James T. Hart and Elton J. Hansen of New Jersey suggested use of this small oiler.

Mosquito Buzz

Directory of Mosquito Control Commissioners in Virginia. The following list of commissioners have full responsibility and direction of mosquito control operations in their respective districts:

Deep Creek	*Suffolk*
G. A. Treakle	E. Lee Everett
Donald Keay	Herbert West, Jr.
East Ocean View	*Tanners Creek*
R. B. McCoy	J. W. Dennis, Jr.
I. A. Johnson	Joseph McDonald
Elizabeth City Co.	*Virginia Beach–P. Anne*
Stuart M. Gibson	W. Peyton May
W. R. Freeman, Jr.	Rev. G. T. Forrester
Newport News	*Warwick County*
Sol Ellenson	J. C. Morris
Lee Todd, M.D.	Jonathan Gibson
Norfolk City	*Williamsburg*
John M. Huff, M.D.	V. D. McManus
Henry George, III	W. C. Drager

Portsmouth
L. H. Denny, M.D.
F. J. Bergeron

Dr. L. J. Roper, State Health Commissioner, is ex-officio chairman of each of the mosquito control commissions. He has appointed R. E. Dorer to act in his place on all the commissions.

The "Skeeter"

Larviciding, New Method, With Small Cans in Portsmouth, Virginia. We have found the following method to be much faster and it uses only about 20% as much oil as the old way of applying straight oil from trombone spray back cans. Laborers on field ditches are equipped with a 5½ ounce spray can and a flask carried in a pocket for refills. Spot checks showed only a fair kill at first; but since laborers and foremen have been instructed to use more larvicide per foot, these checks have shown up as satisfactory.

A very good feature of this method is that inspectors are equipped with spray can and flask and, where breeding is found in spots that cannot be destroyed the place is treated during inspection. This is especially suited to the old tires problem.

Every outside employee of this commission carries a spray can and is instructed to treat all suspicious places seen by him during his daily routine.

The public is inclined to ridicule the method

because of the small amount of larvicide used. Whenever possible, we demonstrate and explain the spreading quality of the new larvicide to anyone offering criticism or showing interest.

We believe that the method will prove successful and economical. With a crew of four laborers, one foreman, one inspector, and a superintendent, we are covering our territory once every ten days; and in addition, we are able to do some necessary bushing and cleaning of ditches.

A. P. PAGE, JR.,
SKEETER, JUNE, 1948

COUNTY OF ELIZABETH CITY MOSQUITO CONTROL COMMISSION. The report to the commission of Superintendent N. S. Beaton for work performed from May 6 to June 2, 1948, reads in part as follows:

"During the period, we changed from large cans to a smaller pressure can for larviciding, also, went from oil as a larvicide to a mixture of DDT; and on close observance, we are finding quite a saving in cost on account of the change. When the men become more accustomed to the new cans, we will be able to effect even more saving."

SKEETER, JUNE, 1948

COUNTY OF WARWICK, VIRGINIA, MOSQUITO CONTROL COMMISSION. In his report for the period May 6 to June 2, 1948, to the commission among other things, Superintendent Beaton called attention to the fact that in changing from large pump cans to small pressure cans and from oil larvicide to a new DDT mixture a considerable saving was effected and that the DDT mixture was found to be very potent.

The following table covering a period of six days' treatment gives some very interesting figures:

LARVICIDING

With Oil

Lin. Ft. Treated	Gals.	Cost	Cost ea. Gal.
42,900	154	$18.64	12.1 cents

With DDT Mixture

Lin. Ft. Treated	Gals.	Cost	Cost ea. Gal.
50,700	29	$9.58	33 cents

Difference:

7,800	125	$9.06

It will be noted from Mr. Beaton's figures that the spraying with DDT mixture covered 7,800 lineal feet more than that covered by the oil, and the cost of the DDT mixture operation was approximately one-half of the cost of oil—a very large saving.

SKEETER, JUNE, 1948

FIRST INTER-AMERICAN SANITARY ENGINEERING CONGRESS HELD IN SANTIAGO, CHILE, APRIL 8–15, 1948. The Inter-American Association of Sanitary Engineering (AIDIS) has now been lifted to a permanent status and provided with its initial group of elected officers as a result of the Association's First Congress held in Santiago, Chile, during April 8–15 of this year.

Mr. Clarence I. Sterling, Jr., of the United States and Mr. Alberto Ortiz Irigoyen of Mexico were unanimously elected first President and Vice-President, respectively, of AIDIS. Mr. Sterling, the present Director of the Health and Sanitation Division of the Institute of Inter-American Affairs, was formerly the Chief-of-Party of the Institute's Chilean and Paraguayan field offices. He was previously connected with the Sanitary Engineering Department of the Massachusetts State Board of Health. Mr. Ortiz Irigoyen, who also holds the position of President of the Association's Mexican Section, is the Chief, in Charge of Construction for Mexico's Secretaria de Recursos Hidraulicos. This agency is directly responsible for sanitary works planning and construction in that country. The Congress also elected Mr. Donald L. Snow, Sanitary Engineer with the U. S. Public Health Service assigned to the Pan American Sanitary Bureau's Lima, Peru, and Washington, D. C., offices to serve as General Secretary of AIDIS. Mr. Snow was previously employed by the Wisconsin State Board of Health.

Mexico City has been selected as the site of the Second Inter-American Sanitary Engineering Congress scheduled for 1949. This news was disclosed by the group's Board of Directors at the final session of the Congress. The dates and details of the meeting will be announced in the near future by the Mexican Section which is in charge of the arrangements.

By far the most successful of the three meetings which have been held, the Congress drew more than 250 members of AIDIS from 19 of the American Republics. Particularly large delegations attended from Argentina, Brazil, Peru and Venezuela. The Congress was honored to have the President of Chile, Mr. Gabriel Gonzalez Videla, present and officially open the sessions on April 8.

At the meeting it was called to the attention of those persons attending that the Association now has over 1,300 active members from the 21 Republics and that national sections have been formed in the majority of the countries. Adhering to the policy of conducting the major part of its activities in cooperation with or through the present structure of professional societies in each of the countries, the various national sections have enjoyed particularly close relationships with other allied professional and scientific groups.

Papers on present and future programs of the national sanitary engineering departments in the various republics occupied the spotlight at the meetings as did a number of contributions on the development of water supplies. Malaria control engineering problems again drew the attention of a large group of the sanitary engineers present.

One of the most successful features of the program was the large industrial exhibit of equipment used in the sanitary engineering field. More than a score of manufacturers from the two continents demonstrated their products there.

News release contributed by H. L. T.

Usually, it is the AMCA members that attract mosquitoes, but in the past year or so, mosquitoes in the Far North have been attracting members! Dr. Fred C. Bishopp and Harry Stage are among those most recently thus attracted away from Washington. In July, Dr. Fred flew to join Barney Travis in Alaska, and Harry travelled to the Arctic Circle. H. L. T.

The AMCA had a wedding in its midst not long ago! Those attending the spring meetings in Florida who had the pleasure of becoming acquainted with the lovely Ernestine Basham and Mr. D. C. Thurman of Jacksonville, will be happy to learn that the lady is now Mrs. D. C. Thurman. Incidentally, they expect to attend the AMCA meetings in California next February, so it is suggested that you extend your personal "Best Wishes for the Future" to them in Berkeley.

H. L. T.

The *Servicio Especial de Profilaxia* of Bolivia has changed its name to *"Division de Endemias Rurales,"* as announced in the following circular received by the Editor:

Cochabamba 31 de mayo de 1948

CIRCULAR No. 37/48

Señor:

Nos es grato hacerle conocer que el organismo hasta ahora conocido con el nombre de Servicio Especial de Profilaxia, mantenido por la cooperación del Gobierno de Bolivia con la Fundación Rockefeller, que tenin por objeto el control de la fiebre amarilla, el paludismo, la uncinariasis y la peste, habiendose hecho cargo ultimamente del control del tifus exantemático he pasado a denominarse en adelante *"División de Endemias Rurales."* La dirección de esta División sigue siendo la antigua del Servicio, a la cual le agradeceremos dirigirse:

División de Endemias Rurales
Avenida Ballivian 638
Cajon Postal 516
Cochabamba, Bolivia

La dirección telegráfica continua siendo "Rockfound" Cochabamba.

Con este motivo reitero a Ud. mis consideraciones mas distinguidas.

(Signed) DR. NEMESIO TORRES MUÑOZ
Director de la División de
Endemias Rurales

Perry W. Ruth, President of the Virginia Mosquito Control Association, sent the following letter to members of his Association:

"As you know we are in the midst of our mosquito breeding season which makes it inadvisable to hold a general meeting of our Virginia Mosquito Control Association during the summer months. Knowing your interest in the welfare of our Association I feel it my duty, as your President, to keep you advised as to the progress that is being made.

"For your information we now have ten mosquito districts which include Virginia Beach–Princess Anne County, Newport News, Portsmouth, Williamsburg, Suffolk, Elizabeth City County, Warwick County, Deep Creek and Tanners Creek in Norfolk County and the City of Norfolk. In addition, mosquito control is being carried on in the cities of Hopewell and Richmond. The U. S. Army and Navy are undertaking extensive mosquito control work in their various jurisdictions and, their work, which is coordinated with the local effort, is an important factor in the over-all mosquito control movement.

"It has been largely through the untiring efforts of this Association that the General Assembly and many communities have been enlightened as to the need for mosquito control in Virginia. The importance and value of this educational program cannot be overestimated."

H. L. T.

The Fourth International Congresses on Tropical Medicine and Malaria were held in Washington, D. C., May 10–18. Forty-five countries, including the U. S., were represented, and a total of 1,256 persons attended.

The meetings were held in three auditoriums simultaneously. There were 12 Sections: research and teaching, institutes, tropical climatology and physiology, bacterial and spirochaetal diseases, virus and rickettsial diseases, malaria, helminthic diseases, protozoan diseases, nutritional diseases in the tropics, tropical dermatology and mycology, tropical veterinary medicine, public health, and medical and veterinary entomology. Dr. Fred Bishopp was Convener of this last Section.

Secretary of State George Marshall delivered an inspiring address at the opening session. That evening, Assistant Secretary of State and Mrs. Thorp invited the delegates and members to an official reception at the Pan-American Union. Other social highlights included Mrs. Harry S. Truman's tea at the White House for the women of the Congresses, and the colorful garden party at historic Dumbarton Oaks for the entire group. A Sunday morning boat ride down the Potomac to Mt. Vernon was climaxed by a wreath-laying ceremony at the tomb of George Washington. Music throughout the Congresses was furnished by the Army, Navy, and Marine Bands.

One night was devoted to a commemorative celebration of Walter Reed's demonstration of

mosquito-transmission of yellow fever. Dr. Philip Hench of the Mayo Clinic gave the main address; and there were present some of the volunteers from the original experiment. A second celebration was held another evening in commemoration of the 50th anniversary of the discovery by Sir Ronald Ross of the method of malaria transmission. Sir Malcolm Watson was the principal speaker; and during his address, he spoke in glowing terms of the accomplishments of the two Americans, Herms and Gray.

There were conducted tours of the laboratories of the Army Medical Center, Naval Medical Center, and the National Institutes of Health. An outstanding event was the excursion to the 12,000 acre Agricultural Research Center at Beltsville, Md. A motorcade of nine buses transported the party directly from headquarters in downtown Washington to the airfield of the Bureau of Entomology and Plant Quarantine, where demonstrations of ground and air equipment for insect control were held throughout the day. A picnic lunch (hot dogs and all) was served; and a delightfully informal atmosphere prevailed as the delegates relaxed and ate as they sat on the grass, boxes, or plank benches. The blazing sun and cooling breeze conspired to endow most visitors with an identifying mark for the remainder of the Congresses—a brilliant sunburn!

The N. J. Mosquito Extermination Association sent Dr. Bailey Pepper and T. D. Mulhern as official delegates, and the AMCA sent Dr. Glasgow and Harry Stage. Dr. and Mrs. Herms were among the Californians present.

Foreign delegates included many well-known investigators in malaria, mosquito, and related investigations. Among these were: Doctors Gabaldon, A. Missiroli, G. Raffaele, N. H. Swellengrabel, F. J. C. Cambournac, F. J. Dy, P. A. Buxton, A. Galvão, Lt. Col. M. K. Afridi, Major General Sir Gordon Covell—and dozens of others just as nice, just as interesting, and all of whom impressed us and cause us to say, "Thank you for coming, we hope to meet you again."

H. L. T.

There once was a fellow named Peter,(s)
Who struck at an active young skeeter,
The skeeter struck first,
And so quenched her thirst
For the skeeter was fleeter than Peter.(s)

A man in a jeep saw the skeeter
He said, "I know just how to treat 'er."
He fogged up the street,
Skeeter couldn't retreat
For the fog, it was fleeter than skeeter!

—Contributed by JOHN PANZAK, Fowler Area,
Consolidated MAD--*Mosquito Buzz*

EDITORIAL SECTION

MOSQUITO CONTROL IN RETROSPECT AND PROSPECT *

PAUL F. RUSSELL, M.D.
International Health Division, The Rockefeller Foundation

Man probably always has been plagued by mosquitoes. Fossil specimens indicate that there were *Culex* species on earth long before the appearance of human beings. Our forebears in their caves probably slapped these irritating insects and used smudges to stupefy them, even as do Australian aborigines today, in their haystack igloos in Arnhem Land of Northern Australia.[1] Very likely the first method of mosquito control was hand-killing and the second, the use of repelling and stupefying smoke.

Mosquito repellents also probably date back many centuries. Certainly, all primitive peoples in the tropics employ materials such as mud, coconut oil, fish oil, and infusions of certain plants to protect their skin from insect bites. These home-made repellents have some value although not much more than any of the 1,001 concoctions which were suggested by scientists prior to World War II. Now, thanks to the studies of the Orlando and other laboratories during and since the war, there are mosquito repellents of practical value.[2]

Perhaps next in man's armamentarium for mosquito control came mosquito nets. Ross [3] tells us that Herodotus, the Greek historian who lived in the fourth century before Christ, was surprised when he first saw bed nets in Egypt. Ross also quotes Horace as having once said, "And among the military standards, oh, shame! the sun sees a mosquito curtain." I am not sure just what Horace meant. The passage quoted could mean that as the sun rose and the standard bearers grouped together to lead the way into battle, some laggard, comfortably sheltered beneath a mosquito net, was oversleeping. Horace may have been heaping shame on late sleeping rather than on the use of bed nets. However, a Roman poet called Propertius, in the first century before Christ, apparently used the word "disgraceful" to describe these mosquito curtains. He and others seemed to think them unmanly. Even today, in and out of the Armed Forces, I have encountered the same phenomenon—a behavior characteristic worthy of study by psychologists. But despite this handicap, mosquito curtains have come to be used in all parts of the world, at least among the well-to-do. They are still beyond the purchasing power of the average tropical peasant.

No date can be named for the time when the use of netting was extended in scope from protecting a sleeping individual to making an entire room or house safe from mosquitoes, but this must have occurred many years ago. Wire screen cloth was manufactured at least as early as 1857.[4] Today there are marketed many different kinds of screen cloth made from threads of cotton, of local fibers such as sinamay and hemp, of plastics, and of metals like steel, copper, bronze, monel and aluminum.

Another ancient mosquito control measure is drainage. It was used in Italy back in the early days, although doubtless at first it was largely employed for agricultural purposes.[5] We have no certain evidence that a relationship was observed in ancient times between drains and mosquito abatement, but the relief from pest mosquitoes after swamp drainage is often so spectacular that it must have been noticed. When Columella, in the first century B.C., wrote that bogs breed insects

* Paper read at joint meetings of the American Mosquito Control Association and the Florida Anti-Mosquito Association at Fort Pierce, Florida, March 29, 1948.

armed with stings, he was very likely referring to mosquitoes.

A more recent mosquito control measure is the use of larvicides. We know that in 1793 oil—possibly whale oil—was used in Philadelphia rain barrels to kill mosquito larvae. Howard tells us that as a boy in 1867 he used kerosene to kill mosquito larvae in a water trough in Ithaca and in 1892 he conducted careful experiments on a mosquito breeding pond.[6]

Petroleum was an ancient discovery. Herodotus described oil pits near Babylon and Pliny mentioned the use of oil for illumination in Sicily. In the 13th century, Marco Polo referred to the oil springs of Baku. Petroleum was described in America in the 17th century. It would be surprising if no one prior to 1793 had noticed that petroleum will kill mosquito larvae. However, the active growth of the petroleum industry did not begin until about 1860 and the extensive use of oil larvicides dates from the days of Gorgas and LePrince in the Panama Canal Zone, after 1904. Since then, tremendous quantities of oil have been used in all parts of the world against all types of mosquitoes.

In 1921, Barber and Hayne demonstrated Paris green as an *Anopheles* larvicide and this chemical has had very wide usefulness all over the world.

Many other insecticides have been used against mosquito larvae and adults in modern times. Pyrethrum powder, for instance, was introduced into Europe from Persia early in the 19th century and into this country in 1860.[7] Kerosene extracts of pyrethrum have been popular for decades as household sprays and during the 1930's this insecticide was developed into a very useful community weapon for spray-killing mosquitoes.

Since 1942 we have had DDT, thanks to Swiss scientists, to the Allied Armed Forces, to the Orlando laboratories of the Bureau of Entomology and Plant Quarantine, to the Tennessee Valley Authority, to the U. S. Public Health Service laboratories in Savannah, and to many other investigators and demonstrators.[8] This modern insecticide opens a new era in mosquito control.

As mosquitocides have become more potent, so too, methods of application have improved, and there are now available a wide variety of instruments and technics, ranging from small hand sprayers to modern spray-distributing helicopters. In the year 1947, for example, aircraft in the United States dispersed mosquitocides of one kind or another on a cumulative total of more than a million acres.

So much for weapons, now for landmarks. Until the work of Ross and the Italians in 1898, mosquito control was carried out simply to abate personal or public nuisances. Then came the revelation that mosquitoes can act as vectors of malaria, of yellow fever, and of other diseases. This landmark led to the magnificent anti-mosquito campaigns of Gorgas, LePrince, Carter, and their colleagues in Havana and Panama, of Watson, Hunter, and Scharff, and others in Malaya, and of enterprising health officers from Hong Kong to Rio de Janeiro.

Between 1900 and 1910 when such excellent work was being done in certain tropical lands, relatively little mosquito control was accomplished in the United States, aside from small projects on Staten Island, New York, and in California, and in a few other places. One local achievement, however, was the stamping out of yellow fever in New Orleans in 1905 by means of anti-mosquito measures. But most observers at that time felt that the disease was controlled more by isolating patients from mosquitoes than by destroying the insects. Probably as late as 1910 a majority of scientists in the United States had serious doubts about the practical value of Ross's doctrine of mosquito reduction to control mosquito-borne disease.

In 1913–1916, the U. S. Public Health Service carried out in Roanoke Rapids, N. C., and in Electric Mills, Miss., successful demonstrations of malaria control by anti-mosquito measures. About the same time, this Health Service, in cooperation with the International Health Board of The Rockefeller Foundation,

completed other successful and useful demonstrations in Arkansas.

Then the United States entered World War I. Immediately there revived memories of the disastrous effects of malaria and yellow fever in the Civil and Spanish-American Wars. There was serious concern that a concentration of recruits in southern camps might lead to epidemics of mosquito-borne diseases. This well-founded fear stimulated a large anti-mosquito project carried out within cantonments by the Army and Navy and, in extra-cantonment areas, by the U. S. Public Health Service. During the period of the first World War there were no fewer than 43 anti-mosquito projects in 15 states, protecting one and three-quarter million civilians and over 800,000 constantly changing Army and Navy personnel. While not perfect, the results of this project, a landmark in mosquito control, were impressive and led to progress which has continued to this day.

Another landmark had been the demonstration by Watson [9] in Malaya that Ross's strategy of malaria control by general mosquito reduction could profitably be modified to prophylaxis by *species control*. It is not necessary to fight all mosquitoes but only the particular species which are dangerous or troublesome. Watson thus brought mosquito control into focus. Samuel Taylor Darling in Panama as well as in the United States, Hackett and Missiroli in Italy, and many others in various parts of the world soon proved the practical value of Watson's demonstration.

The organization and practical success of the New Jersey Mosquito Extermination Association, and similar projects in Florida, California and elsewhere, proved the economic value of dealing energetically with pest mosquitoes.

But even as late as 1936, one was forced to conclude that man did not know how to control malaria or mosquitoes in the rural tropics at a price the people could pay on a routine community-budget basis. There were no financially feasible malaria control measures for areas of low economic levels.[10] Costs of control procedures available for such places were 50 cents to $2 or more per capita per year. To be practical the cost in the average rural tropical community must not exceed 10 cents per capita per year. Others agreed with this observation.[11] Then in South Africa was developed the pyrethrum spray-killing of adult *Anopheles*. The method had wide usefulness. Soon, for example, it was demonstrated that malaria could be controlled in an average South India village for as little as 8 cents per capita per year.[12] This is a practical figure in such areas. Now, with the added values of residual DDT, one feels certain that malaria control by an attack on the adults of vector anophelines is today economically feasible for many tropical communities, rural and urban.

The demonstration by Soper and Wilson and the Brazilian Malaria Service, in 1939–1940, showed that a species of *Anopheles* can be completely eradicated from an area.[13] One large factor in the success of this project was the previously successful demonstration of the possibilities of *Aedes aegypti* eradication by a nation-wide anti-*Aedes* organization in Brazil between 1926 and 1940.[14] Both personnel and training from the first project were used in the *Anopheles gambiae* compaign.

The extirpation from Brazil of the African species, *A. gambiae,* was a sanitary triumph and suggested the possibility of eradicating other vector species. Today, for instance, there are active projects in Sardinia and Cyprus which are designed to eliminate entirely the local malaria vectors. Whether this will prove to be economically feasible in an average area remains to be seen, but it is a bold and promising concept.

As in the first, so throughout the second, World War, mosquito control was given a great deal of attention and the Armed Forces were able to deal with pest and vector species under all sorts of conditions in every part of the world. All

the accepted weapons were put to full use, and new ones were developed.

During World War II we learned again that mosquito control is never automatic or simple. It requires law and persuasion, organization and training, money, supplies, and technical application. In civil or in military life, mosquito control requires a professional organization to survey, plan, perform, supervise, and maintain the numerous technical procedures continuously required.[15]

A project called *Malaria Control in War Areas* was organized by the U. S. Public Health Service in March of 1942. In cooperation with several state health departments, this program was successful in controlling anopheline mosquito production in extra-cantonment zones of military and war-connected establishments. No fewer than 2,000 such zones were under control by the end of 1944. The project was enlarged in 1945 into what was called *The Extended Program,* designed not only to continue to protect military cantonments but also to guard against the hazard of malaria outbreaks due to malaria carriers returning from overseas. Having protected soldiers from civilian malaria during the war, the project was extended to protect civilians from military malaria. This objective was fully met and there were no malaria epidemics in the United States in 1945, 1946, or 1947.

In July, 1946, Malaria Control in War Areas and The Extended Program were merged into a new U. S. Public Health Service project called *The Communicable Disease Center.* This undertaking embraces much more than malaria control, yet in the latter field its aim is no less than the eradication of endemic malaria in the continental United States. Under the auspices of C.D.C. and in cooperation with various states and counties, there were over two million house sprayings with DDT in the southeastern United States in 1947. This was a most important and concentrated attack on *Anopheles quadrimaculatus.* Here is another conspicuous landmark in the history of malaria and mosquito control.

But where do we go from here? Obviously, malaria will soon become a rare disease within the continental United States. Moreover, DDT is reducing malaria to modest proportions in Greece, and it bids fair to do the same in Italy, in Venezuela, and in several other traditionally malarious areas throughout the world.

In the future, therefore, we may not always expect to obtain funds for mosquito control on the basis of the need for malaria prophylaxis. So, where malaria appears to be a vanishing disease and monies for mosquito control are still budgeted under items for malaria prophylaxis, it would seem to be a forward step to change the budgetary designation. Where residual DDT is being applied on a malaria control basis, it would be good strategy to widen the concept to one of routine sanitation of premises, stressing the broad insecticidal benefits of DDT rather than simply protection from chills and fever. Otherwise those who control the funds may ask why a malaria budget is required in the absence of malaria. Although it has importance, the argument that we want to prevent reappearance of malaria may not carry sufficient weight with the short-memoried public.

Another point which should be noted is the danger that we may be so impressed with DDT that we will neglect naturalistic methods and such substantial anti-mosquito works as drainage and water regulation. One of the great lessons to emerge from the outstanding Tennessee Valley Authority malaria control experiences has been a demonstration of the value of building malaria control into a project—into the very dams and reservoirs themselves. We must emphasize that DDT does not obviate the need for permanent mosquito control measures in many areas.

Finally, it seems to me that those of us who are interested in mosquito and malaria control must begin to stress the fact that although chills and fever are no longer a major problem in the United States, yet malaria as a disease has very

great importance to this country. There are at least four basic reasons. These are (1) national defense, which contemplates the possibility that our Armed Forces may some day have to deal again with malarious areas; (2) world food requirements—there is a vital need to open up malarious areas to greater food production; (3) needs of American business—it is expanding into malarious countries at an increasing rate; (4) the increased cost to us in dollars and cents of every product we import from a malarious country. It seems to me likely that our imports from malarious countries carry a hidden malaria tax of about 5 per cent. If this be true, then in 1938, for instance, malaria in the 29 malarious countries from which we bought needed products cost us over 175 million dollars.

Just as England was and is willing to spend large sums of money on malaria research although malaria is not a problem at home, so we should take a broad view, reorienting our thinking as regards this mosquito-borne disease which is still one of the most important in the world. The power of DDT and the reduction of malaria in the United States must not be allowed to mislead us into a belief that the mosquito and the malaria stories are ended. Our children will hear a good deal about the seriousness of malaria in tropical Africa and Asia and in certain other areas from which we must obtain vital foodstuffs and other necessities. Moreover, the conquest of pest mosquitoes even in this country is still a problem of great importance. No, we are not at the end of the mosquito control road. We have a long and difficult journey ahead and we shall need the help of basic research and original thinking for many years to come.

We must set our sights high and aim at nothing less than the complete control of pest mosquitoes in the United States, and the subjugation of mosquito-borne disease throughout the world. Such concepts today are not absurd; they are bold but practical. The Expert Malaria Committee of the World Health Organization expects to draft plans for a world-wide attack on malaria. The American Mosquito Control Association might well consider drafting, with the help of local societies, a comprehensive nation-wide plan for dealing with pest mosquitoes at home.

The United States is now the world's paramount nation. As an English economist has said, we hold the keys of life and death, we have unparalleled power to influence the course of civilization in cultural, industrial, and political development. In the specialized field represented here today, let us do what we can to keep the United States in the vanguard of research and development, looking forward to that day when not only our own land but the world itself will be rid of crippling mosquito burdens.

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CORRESPONDENCE

AN ADDITION TO THE PERMANENT FUND

LETTER TO THE SECRETARY AND REPLY

July 21, 1948

Mr. Thomas D. Mulhern, Sec.-Treas.
American Mosquito Control Association
New Brunswick, N. J.

Dear Mr. Mulhern:

Thank you for your letter of July 15 and for the check of the Association in the amount of $400 enclosed.

In accordance with my letter to you of July 3, I am attaching check in amount of $500 from monies remaining in the Edwin Gould Malaria Fund, which $500 we agree is to be placed in the permanent revolving fund of Association.

It was a pleasure to be able to lend some aid to the Association in its publication of the excellent and very much needed booklet "The Use of Aircraft in the Control of Mosquitoes" and I am glad that the venture has turned out so well, and that you were able to repay the $400 loan on time. Hope the permanent use of the attached check will help the Association to carry on this good work.

With kindest personal regards to you and to your associates, I am

Sincerely,
H. W. VAN HOVENBERG

Copy

July 23, 1948

Mr. H. W. Van Hovenberg
Engineer of Tests and Sanitation
St. Louis Southwestern Railway Company
Mt. Pleasant, Texas

Dear Mr. Van Hovenberg:

On behalf of the American Mosquito Control Association, it gives me great pleasure to express our sincere thanks for your action in making available for placement in the permanent revolving fund of the association, the sum of $500 from the Edwin Gould Malaria Fund. Check in the above amount having been received today.

This amount will help immeasurably for us to finance the future publications of the association in a business-like way and you may be sure that the association will use it to good advantage in furthering the good work of mosquito and malaria control.

With kindest regards, I am,

Very truly yours,
THOMAS D. MULHERN
Secretary-Treasurer
American Mosq. Control Assoc.

TDM:il

HOW UNION COUNTY, NEW JERSEY, MET CURRENTLY TROUBLESOME PROBLEMS

LETTER TO THE EDITOR

Dear Dr. Glasgow: I am enclosing a copy of our new circular of information entitled "Builders — Prevent Mosquito Breeding."

This season has been rather unusual in that we have a predominance (over 50%) of *Culex pipiens* in our mosquito traps while the heavy rainfall should have caused *Aedes vexans* to be very heavy. We have our 16,000 catch basins under excellent control with the motorcycle unit using 3% DDT in fuel oil. The yard inspections were resumed for the first year since 1942 but the entire county will not be covered due to the necessity of training new inspectors.

Due to the unprecedented number of new homes being built in Union County, I checked on breeding of mosquitoes at new construction sites. In one town of

20,000 population there were 150 cellar holes or new foundations breeding mosquitoes. Assuming each cellar averages 500 sq. ft. of water surface, we had two acres of mosquito breeding well distributed over the town. This presented a serious problem because our spray crews larviciding regular carded areas have no way of keeping up with new construction except by chance.

I decided on an educational program and developed the enclosed circular. The various steps of the program are:

1. Newspaper articles on the problem and featuring the circular.

2. Letter to each Mayor with a copy of the letter to each local Board of Health. A copy of circular accompanies each letter.

3. Distribution of supply of circulars to each local Building Inspector to be issued with each new building permit. He will also post one on each current job.

4. Distribution of supply for each union member to every union delegate covering the various building trades in the county.

5. Mailed one circular to each architect and building contractor in the county.

6. A spray crew visits every new construction job. The foreman inspects the job for breeding, shows the builder what mosquito breeding is, sprays the breeding at no cost to builder, posts a circular, and informs the builder to keep it under control in the future by following the rules.

We are currently in the process of carrying out the above steps and are looking forward to a reduction in our *Culex pipiens* mosquito population. You might care to use this material for MOSQUITO NEWS.

Very truly yours,
R. J. VANDERWERKER
Superintendent-Engineer

RJV:R

BUILDERS!

PREVENT MOSQUITO BREEDING

Over ½ of the county mosquito population is traceable to carelessness and destruction to drainage by contractors and builders. You can prevent all of the mosquito troubles resulting from your work by a little thought and not over a dollar in cost.

The Mosquito Commission can not keep up with all of the new construction going on all over the county and carry on their regular work too. The commission has drawn up a few simple rules for you to follow and beg your cooperation in compliance to keep our county free of mosquitoes.

RULES

1. Don't fill, block, or divert a drainage channel, ditch or pipe crossing your lot or development without calling us at CRanford 6-1164. You will find us cooperative if called beforehand and it may save you a lot of money.
2. Don't store materials, equipment, or containers so they will collect and hold rainwater.
3. Have your mason and plaster contractors invert mortar and plaster containers when they finish using them. Fresh plaster does not prevent mosquito breeding.
4. Have the painting contractor punch holes in the bottom of all paint cans. They breed heavily when full of rain water and are hard to locate in the brush and weeds of the vacant lot next door.
5. Spread kerosene or fuel oil on water in basement weekly until you have it drained. One gallon weekly is adequate for the cellar of an ordinary house.
6. Spread kerosene or fuel oil every week on pools of water in the lot while waiting for your grading contractor.
7. Stop in the office or call us for further information or help at anytime.

One cellar foundation with 1 inch of water can cause sleepless nights for three blocks in all directions from your job. One destructive developer can nullify all our work in a town or city.

We again beg your help and cooperation and are sure that nearby neighbors will appreciate it. *Non-Compliance will be referred to the local Board of Health for Action.*

R. J. VanDerwerker, SUPT.-ENGINEER

UNION COUNTY MOSQUITO EXTERMINATION COMMISSION
324 NORTH AVENUE, EAST CRANFORD, N. J.
CRanford 6-1164

MINNESOTA APPRECIATES THE AIRCRAFT BULLETIN

LETTER TO THE SECRETARY

Dear Mr. Mulhern: You have probably noted that within the last two or three weeks you have had considerable correspondence from Minnesota, North and South Dakota residents, requesting copies of your excellent publication, "Use of Aircraft in the Control of Mosquitoes." In working in very close cooperation with aircraft spray and dust operators in Minnesota, pointing out to them sources of information for mosquito control, as well as other pest control operations, your publication is the best that I know of, so I have been recommending it for purchase by those people concerned.

Our Legislature still has not passed an enabling act for the formation of mosquito abatement districts in Minnesota, however, many municipalities and communities are appropriating funds for mosquito control work. I believe that there is a gradual awakening to the fact that mosquitoes can be controlled, or at least the numbers reduced, and that a great upsurge in abatement will result. I am also recommending membership in the Association to many of these operators who intend to get into the work. Of course, most of our operators are primarily interested in the application of weedicides and sprays for corn borer control but are awakening to the possibilities of application of insecticides for mosquito control.

Again I wish to congratulate you and the editorial staff on the publication of so fine a bulletin.

Very truly yours

A. W. BUZICKY
Associate State Entomologist
University Farm, St. Paul, Minn.

A TAX LEVY IS REDUCED *

When we put a "good news" heading on the story about the 1949 tax rate of the Consolidated Mosquito Abatement District, we did it believing that our readers, generally, would agree that the story was really an item of good news.

The mosquito tax has been 30 cents per $100 of valuation this year because, with the approval of the board of supervisors, the mosquito district levied tax for two years of operation in one taxation year so as to get the program going on sound financial footing. That tax rate was set for only one year with the understanding that the district would drop back to its legal maximum of 15 cents per $100 for the fiscal year starting next July 1.

The board of trustees of the district, however, have done better than their promise and have shaved three cents from the maximum levy, setting up a rate of 12 cents per $100 of valuation. That's the best part of the story, the fact that the board could find ways of getting down below the maximum tax levy permitted by state law. There is hope that as the program develops the tax rate may go even lower, but the management of the district has made no definite promise, realizing that the future is too uncertain for that.

To the management of the Consolidated Mosquito District, and to the board of trustees who supervise the affairs of the organization, therefore, we offer a well deserved expression of appreciation on behalf of the taxpayers of the district. The board and the management have handled the affairs of the district well, have practiced economy in operation, and now can come to the people with a refreshing announcement that in these days of rising costs of everything else, our mosquito abatement program next year is going to cost us less than we expected.

* Copied from the REEDLEY EXPONENT (Reedley, California) for Thursday, June 3, 1948.

REVIEWS AND ABSTRACTS

THE GROWTH OF *Anopheles sergenti* THEOBALD (DIPTERA, CULICIDAE), WITH SPECIAL REFERENCE TO THE GROWTH OF THE ANAL PAPILLAE IN VARYING SALINITIES. By D. S. Kettle. Ann. Trop. Med. and Parasit. 42(1): 5–29. 1948. Measurements made on a total of 500 laboratory reared larvae of *Anopheles sergenti* Theobald are analyzed in studying the growth of this mosquito. Of these larvae 125 were in each of the 4 larval instars.

Seven measurements were made on each larva: length of head, breadth of head, length of thorax, breadth of thorax, length of second abdominal segment, breadth of second abdominal segment and the length of the dorsal anal papillae.

From the analysis of the data obtained by these measurements several facts were learned. One is, that the head shows discontinuous growth, with a dramatic increase in size at each ecdysis. The growth coefficient between the head breadth and the thorax breadth was found to be 1.0. The thorax undergoes heterogonic growth, undergoes no sudden change at ecdysis but grows continuously throughout larval life, the length increasing more rapidly than the breadth. The second abdominal segment also grows continuously throughout larval life, the growth rates of its breadth and length being the same. The dorsal anal papillae show a mixed pattern of growth, since they not only grow steadily, though slowly, during an instar, but also have a sudden increase at ecdysis.

Various other workers cited in the paper have demonstrated that the lengths of the anal papillae of the larvae of certain species of mosquitoes steadily decrease with increasing salinity. In studying this phenomenon, the author found that the intra-instar growth rates of fourth stage larvae of *A. sergenti* bear no relation to the lengths of the anal papillae. It is suggested that the variation in lengths of the anal papillae of larvae reared in different salinities is determined by the same mechanism as that which controls the chloride content of the haemolymph.

Studies were made of 52 breeding-places of *A. sergenti* in nature and 25 were found to be below 0.1 percent NaCl in the range of salinity where small changes produce large differences in the length of the anal papillae. Although the length of the anal papillae of *A. sergenti* may prove useful as a specific taxonomic character under certain conditions, it is unlikely to be a critical one.

This study dealing with certain growth conditions and physiological reaction of *A. sergenti* provides useful information tending toward a more complete understanding of the bionomics of mosquitoes. The analysis of the data supporting the author's statements is presented in detail in order that the reader may follow the development of the author's investigations and thoughts.—D. C. THURMAN, JR., U.S.P.H.S., Florida State Board of Health, Jacksonville, Florida.

LARGE SCALE INSECT CONTROL PROBLEMS. By F. C. Bishopp. Soap and Sanitary Chemicals, February, 1948. The author, in his usual effective manner, issues a challenge for large scale insect control operations. He evaluates the importance of insect control in this fast moving world of today bringing out the point that the population is increasing, resulting in the need for more food, the depleting of soil fertility is reducing the food supply, and fast transportation is helping to spread insects. These are all factors that have made the insect of increasingly greater importance in recent years. On the brighter side, he indicates that much more effective weapons against the insects are now available, referring, of course, to the new synthetic organic insecticides and new devices for applying them. He enumerates the limitations in residual spraying, bringing out the possibility of toxicity to higher animals, the varying surfaces upon which the residual deposit is being applied, and the recent apparent failures of DDT, which might indicate a resistant insect strain. The latter, of course, may develop into the most important of all. Several other compounds of promise are enumerated with some of the results obtained thus far. The author states that in large scale field operations many complicating factors are certain to be encountered. The effects of long-time residuals may so effectively control one insect that another not affected might become a worse pest. It is generally agreed that when minimum dosages are applied for a specific insect, the general insect population other than the specific insect being fought is knocked down but returns approximately to normal numbers the following year or even sooner. Several large scale operations under government control are discussed in this article, and it is brought out that in these undertakings there has been a considerable element of experimentation. Public interest has been aroused, but campaigns are of little value unless they result in continuing efforts. Cooperation of industry, government, and the general population is needed. The author finishes his article by stressing the need for more research and knowledge in the many fields of insect control and closes by asking two pertinent questions. "Under present conditions, can we afford to let five to ten per cent of our grains go to feed these pests? Are we all doing the best possible job to stop these losses?"—R. E. DORER, Dir., Insect and Rodent Control, Virginia State Health Department.

TOXICITY OF DDT RESIDUES. By R. W. Fay, E. I. Cole and S. W. Simmons, Soap and Sanitary Chemicals, 24, 6:130–133, June 1948.

Factors influencing the residual toxicity of DDT-Xylene emulsions, DDT-kerosene sprays, and suspensions of water wettable DDT on various surfaces were laboratory tested to determine (1) the relative effectiveness of DDT-Xylene emulsions on specified surfaces; (2) the comparative effectiveness of DDT deposits from emulsion, solution and suspension applications on specified surfaces; and (3) the effect of cleaning operations on the residual toxicity of DDT deposits.

Samples containing twenty-five, 4 day old *Anopheles quadrimaculatus* females were used in the cage tests on the many surfaces tested. Exposures of 60 minute intervals were used. Immediate knock-down and 24 hour mortality intervals were recorded. Experimental techniques used are described in full. Results obtained are tabulated in full accompanied with narrative descriptions of the results obtained.

Deposits of 200 mg. DDT per square foot of 5 percent DDT-Xylene emulsion gave satisfactory results for 6 months on dry bamboo, bark, and rusty sheet metal. One to 2 month effectiveness was obtained on new sheet metal, glass, tile, palmetto thatch, and new metal screen. Unsatisfactory results were obtained using plexiglass, shellacked wood, cement, and waxed wood. DDT-kerosene deposits on the same surfaces gave a somewhat lower level of effectiveness than DDT-Xylene emulsion while the water-wettable DDT deposits were generally better than DDT-Xylene or DDT-kerosene on most surfaces; superior on cement but nearly non-effective on adobe.

Effects of house-cleaning and maintenance operations on residual DDT deposits were studied showing that dry cleaning rapidly reduced effectiveness on clothing as did the use of a hot iron. Waxed and shellacked floors treated gave very low residual effectiveness. The use of a vacuum cleaner reduced the residual toxicity markedly.—G. EDWIN WASHBURN, Manager, Turlock Mosquito Abatement District, Turlock, California.

CONTROL OF MOSQUITO BREEDING BY THE USE OF DDT SOLUTION ABSORBED ON BRIQUETTES. By W. C. D. Lovett, The East African Med. Journ., 24(5): 196–198. 1947. In this preliminary article the author discusses the need for mosquito control in British Somaliland, where mosquito-breeding is largely in uncovered wells. For example, one square mile alone contains approximately 300 wells. Experimental work was carried out in Haraf, a village with six wells. Each well is uncovered, about 20 ft. deep, 3 to 4 ft. in diameter, and lined with logs and brushwood. The reaction of Culicine larvae only is recorded since they were the only mosquitoes found upon sampling.

Briquettes (about one inch cube), prepared from a mixture of sawdust and plaster of paris (2:1), were soaked in a 5 per cent solution of DDT in diesoline for 48 hours and then stored in tins containing a slight excess of the oil. By dropping one or more impregnated briquettes (each cube gives control of 4 square yards of water surface) into a well, mosquito-breeding was prevented for a month. The treatment apparently had no deleterious effect on the water or at least there were no complaints from the villagers who were using it for all purposes. This control work can be carried out by an unskilled person which is one of the main points of the author's experiment.—LOUISE GOODE, National Institutes of Health, Bethesda 14, Md.

MICRO-ORGANISMS AS ENEMIES OF MOSQUITO LARVAE. (MIKROBIEN ALS FEINDE VON STECHMÜCKENLARVEN.) By H. M. v. Jettmar. Acta Tropica 4(3):193–208. 1947. Article in German, with English and French summaries.

A severe invasion of the larvae of the species of *Culex fatigans* by streptobacilli was observed in summer 1946 in Shanghai. All these infected larvae were secondarily invaded by vorticella to such an extremely high degree that the outer surface of the larvae was covered by a thick mossy-looking layer of these protozoa. The invasion by these streptobacilli, which developed especially in the 3rd and 4th larval stage, was fatal to the larvae in all cases, as they could never hatch into pupae. The *lethality* was therefore exactly 100 per cent and with it the *mortality* as well, as *all larvae* of this species living in the infected pond became invaded.

The pond, where this fatal disease among the larvae occurred proved to be an excellent trap for the female mosquitoes of the species, which proceeded to deposit their eggs there, from which the hatched larvae were doomed to certain premature death.

Observations made during this invasion are described, the histology of the invaded larvae is given and illustrated by photomicrographs. In connection with the description of this outbreak the other hitherto undescribed micro-organisms which are pathogenic to the mosquito-larvae are discussed.—Author's summary.

CALIFORNIA MOSQUITO CONTROL ASSOCIATION OPERATIONS MANUAL. Issued by California Mosquito Control Association, Post Office Box 649, Berkeley 1, California, 1947. $6.00, including additional data sheets to be supplied as issued.

This new manual should be very helpful to the mosquito workers in California, and elsewhere. Sections are specifically designated "Administration," "Operations," "Engineering," "Entomology," and "Miscellaneous," and are so indicated by tabs at the edge of the pages. Provision is made for many types of information, ranging from a guide as to how a meeting of the governing board of a mosquito district should be conducted, through laws and legal responsibilities, biological information, data on insecticides, methods and forms for estimating and recording costs, tables useful in making dilutions of insecticides, etc.

Made up in the form of a loose leaf, mimeographed book with a hard cover, the manual can be easily kept up to date by inserting replacement or additional pages as they are provided by the California Association. The Executive Committee of that organization states that technical memoranda will be issued as information of general value is developed, each memorandum being labeled to indicate the section of the manual in which it should be inserted.

We should like to see more subject headings, or subdivisions of the present broad headings, and should particularly like to see a section of "Definitions." For convenience in making revisions, each might carry a running head showing the date prepared, the section in which it belongs, and a page number. An index, revised annually, could then be issued and would be helpful in using the manual.

The obvious objective of this handbook is to make readily and promptly available to those on the "firing-line" of mosquito control the authoritative information-ammunition which they need to actually control the mosquitoes, and at the same time to promote coordination of the efforts of the several agencies represented in the California Association. We are informed by officials of the California Association, that each of the California Districts is urged to contribute their novel mosquito control observations, findings, and developments for possible use in the manual. They give full credit to the Bureau of Vector Control of the California State Department of Health, for that body is bearing the greater share of the labor of preparation, editing, printing and mailing the technical material. The idea was developed by the Association, and it also furnished the funds for covers and for separators, etc.

The California Association is to be complimented for undertaking this thoroughly worthwhile project.—THOMAS D. MULHERN, Sec.-Treas., AMCA.

DDT AND *Aedes aegypti* CONTROL IN BRITISH GUIANA. By P. F. De Caires. Puerto Rico Jour. Pub. Health and Trop. Med., 22(4):405–415. 1947.

Emanating from the British Guiana Yellow Fever Service, which derives its funds from the Government of British Guiana and the Rockefeller Foundation, this paper chalks up another point for DDT in its contest with the traditional forms of mosquito control. Here again we find an author who is willing to stake all on spraying of houses, for he has found that "this method of *Aedes* control proved more effective and cheaper than routine anti-*Aedes* control measures, even when carried out with inferior spraying equipment." (Administrators, take note of everything except the last phrase!)

The experiment, which began in August, 1945, was undertaken in villages near Georgetown. Part of the houses were subjected to 5 per cent DDT (in kerosene) spraying, part to 2½ per cent DDT, and part to routine anti-*Aedes* control measures, while no work was done in a check area. From an initial index of 26 (percentage of houses with *aegypti* breeding) the 5 per cent DDT area attained an index of 0 in 13 weeks; but the 2½ per cent DDT area and the routine measures area did not reach that low index, even after 35 weeks. A single treatment of 5 per cent DDT spraying remained effective for 10 months. The 2½ per cent DDT treatment was not regarded as being superior to the routine measures. For control of *Aedes aegypti* in large areas the author recommends 5 per cent DDT spraying of houses rather than the usual measures on the basis of greater effectiveness and lesser costs.

Our faith in DDT suffers, however, when it comes to *Culex quinquefasciatus*. "Quinque" was found to be rather resistant to DDT, and the number of breeding places of the larvae was not reduced by house spraying; indeed, routine larval control measures were more effective for this species.

This is a very good paper and in reading it one wishes to compliment the author particularly on the attention he has paid to practical detail—such as personnel, equipment and costs. In this connection, the reviewer would have liked a little more prominence given to the matter of transportation, for according to his own modest experience in government and military insect and rodent control projects, this item is not adequately considered; maybe if enough of the workers mention it in their publications, administrators will give transportation well deserved importance.—IRVING FOX, Department of Medical Zoology, School of Tropical Medicine, San Juan, Puerto Rico.

MALARIA CONTROL ON IMPOUNDED WATERS. Federal Security Agency, United States Public Health Service, and Tennessee Valley Authority, Health and Safety Department, 1947, 422 pages.

Prepared jointly by staff members of their respective agencies, under the guidance of Dr. E. L. Bishop, Director, Health and Safety Department, Tennessee Valley Authority, and of Mr. M. E. Hollis, Sanitary Engineer, Director, in charge of malaria control for the United States Public Health Service. The organization and editorial treatment was under the direction of Mr. C. I. Mansur.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

As the title implies, this attractively clothbound volume is a manual presenting the basic principles and modern practices of malaria control in the neighborhood of impounded waters.

Impoundage of the water in any part of an open drainage system profoundly alters the general biologic balance of the affected area; the resulting changes depending upon the physical and biological characteristics of the environment, and the nature and extent of the operation.

Notable among these changes may be a vast increase in the malaria hazard arising from the attendant increase in potential anopheline breeding water.

A program of regional development, based primarily on water control like that undertaken in 1933 by the Tennessee Valley Authority, therefore, has both demanded, and afforded a unique opportunity for the study and application of malaria control measures on an unprecedented scale. Such work on the more than 10,000 miles of newly created reservoir shore line in a region of widely varying topography, has provided malaria control experience on a scale, and under a variety of conditions never before provided by any single project. The experience of the U. S. Public Health Service has been acquired over a much broader geographic and ecologic range.

Therefore, the manual produced in collaboration by the two agencies combines the experience gained by intensive work on a regional basis with that gained by extensive operations on a national scale, and such a pooling of knowledge, experience, and research effort, together with consultation from other competent authorities has contributed to bring about a sustained increase in the efficiency and economy of control practices as applied in the work of the TVA, and as described in this manual.

In sixteen chapters, this manual covers very comprehensively the various problems and techniques of malaria control in relation to impounded waters with special emphasis on control of the vector Anopheline mosquitoes, as follows:

I. Malaria and Its Relation to Impounded Water.
II. Planning Malaria Control.
III. Reservoir Preparation.
IV. Permanent Marginal Measures.
V. Water Level Management.
VI. Shore-Line Maintenance.
VII. Larviciding.
VIII. Mosquito Proofing.
IX. House Spraying.
X. Facilities and Operation Procedures.
XI. Malaria Mosquitoes.
XII. Malariology.
XIII. The Relation of Plants to Mosquito Control.
XIV. Interrelationships of Malaria Control and Wildlife Conservation.
XV. Personnel Training and Public Relations.
XVI. Small Reservoirs.

Following these sixteen chapters are eight Appendices:

Appendix A. Summary of State Laws and Regulations Pertaining to Malaria Control.
Appendix B. Example of Hydraulic Analysis for Prediction of the Frequency and Duration of Flooding in a Flood Control Storage Reservoir.
Appendix C. Chemicals Employed in Malaria Control.
Appendix D. Equipment, Tools, and Supplies.
Appendix E. Design of Airplane Larviciding Equipment.
Appendix F. Methods of Determining the Recovery of Larvicides on a Water Surface.
Appendix G. The More Important Anopheles Mosquitoes Transmitting Malaria in the Principal Regions of the World with Typical Breeding Places and Usually Applicable Control Measures.
Appendix H. Malaria Survey Diagnostic Technique.

The Manual is well illustrated with tables, graphs, charts, drawings, maps, photographs and aerial views, many of the photographs and aerial views reproduced in color; and the examples of record maps and forms employed for the report of current operations should be useful or suggestive to mosquito control operators everywhere.

It is a book that should be in the library of every mosquito control agency; and, indeed, in the library of every mosquito control worker, as well as in public libraries wherever malaria control or even general mosquito control is an object. —R. D. G.

MALARIA CONTROL PLANS BY THE WORLD HEALTH ORGANIZATION. The report of the Expert Committee on Malaria of the World Health Organization, the 2nd session of which was held in the Pan American Sanitary Bureau Building following the 4th International Congresses of Tropical Medicine and Malaria, Washington, D. C., May 19–25, 1948 has just been distributed (dated June 8, 1948, mimeographed).

The following members of the Committee were present, including Secretary Pampana, W.H.O.: Dr. Arnaldo Gabaldon, Venezuela, Chairman, Major General Sir Gordon Covell, U.K.; Dr. Paul F. Russell, U.S.A.; Med. General Marcel Vaucel, France; Dr. D. K. Viswanathan, India; co-opted members: Lt. Col. M. K. Afridi, Pakistan; Dr. J. W. Field, Malaya; Dr. D. Bagster Wilson, Tanganyika; FAO representative: Dr. Wallace R. Aykroyd; Pan American Malaria Commission Observers: Dr. Carlos A. Alvarado, Argentina; Dr. Paulo C. A. Antunes, Brazil; Dr. Luis Vargas, Mexico; consultants: Dr. G. Robert Coatney, U.S.A.; Dr. Clay G. Huff, U.S.A.; Dr. Fred L. Soper, U.S.A. and Mr. H. H. Stage, U.S.A.

The 50-page mimeographed report is divided into the following ten sections: I. Introduction; II. World Needs; III. WHO Malaria Policy; IV. Agriculture and Malaria; V. Use of Insecticides; VI. Chemotherapeutics in Malaria Control; VII. Research; VIII. Quarantine; IX. Recommended Resolutions; X. Conclusions and Recommendations.

The objectives are well summarized in the Committee's statement "the fundamental purpose of the WHO malaria policy should be to assist

governments to accomplish effective malaria control along modern scientific lines. The Committee believes that this should be done through WHO regional organizations and that it involves practical assistance in formulating programmes and in setting up adequate governmental machinery for malaria control, in training skilled personnel, in disseminating relevant information, in developing uniform international procedure and nomenclature, and in promoting measures to protect countries against the introduction of anophelines from the outside."

Overall original plans for carrying forward malaria control programs are outlined using the malaria organizations in India, Venezuela, and other countries as examples. Methods of training effective workers, demonstrating procedures and conducting public education are outlined.

The cooperative attitude of the FAO is included in a memorandum prepared by that group. They point out that "From the point of view of agriculture, malaria creates two separate types of problems. The first is the case where malaria is endemic in a thickly populated area already under agricultural occupation, where the effect of the malaria is to sap the energy of the working population, and to increase, often at critical periods, the number of working days on which the worker is incapacitated by ill-health. The second is where malaria is preventing the development of an area otherwise suitable for agricultural development." Also "To assess the effect of malaria control, economic surveys should be made in rural areas selected for demonstration malaria control projects. Such surveys should be made before the initiation of control measures and again at a later date when they have taken effect."

The use of insecticides in malaria control, their application, production, availability and cost are discussed in Chapter V. In Chapter VI modern therapeutics for malaria are treated. The situations in which drugs have a place are pointed out and the importance of antimosquito measures are stressed as indicated by the statement, *"The Committee,* considering that there would be general agreement that the primary consideration in the communal control of malaria is the interruption of transmission at the mosquito level, recommends that measures so directed should be given priority by health authorities wherever possible."

In section VII research fields which urgently require attention are well presented including experiments in species eradication.

The importance of preventing spread of malaria carriers and procedures to be followed are presented in Chapter VIII, and the final section deals with conclusions and recommendations regarding the whole malaria situation and the part WHO may play in its improvement.—F. C. BISHOPP.

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